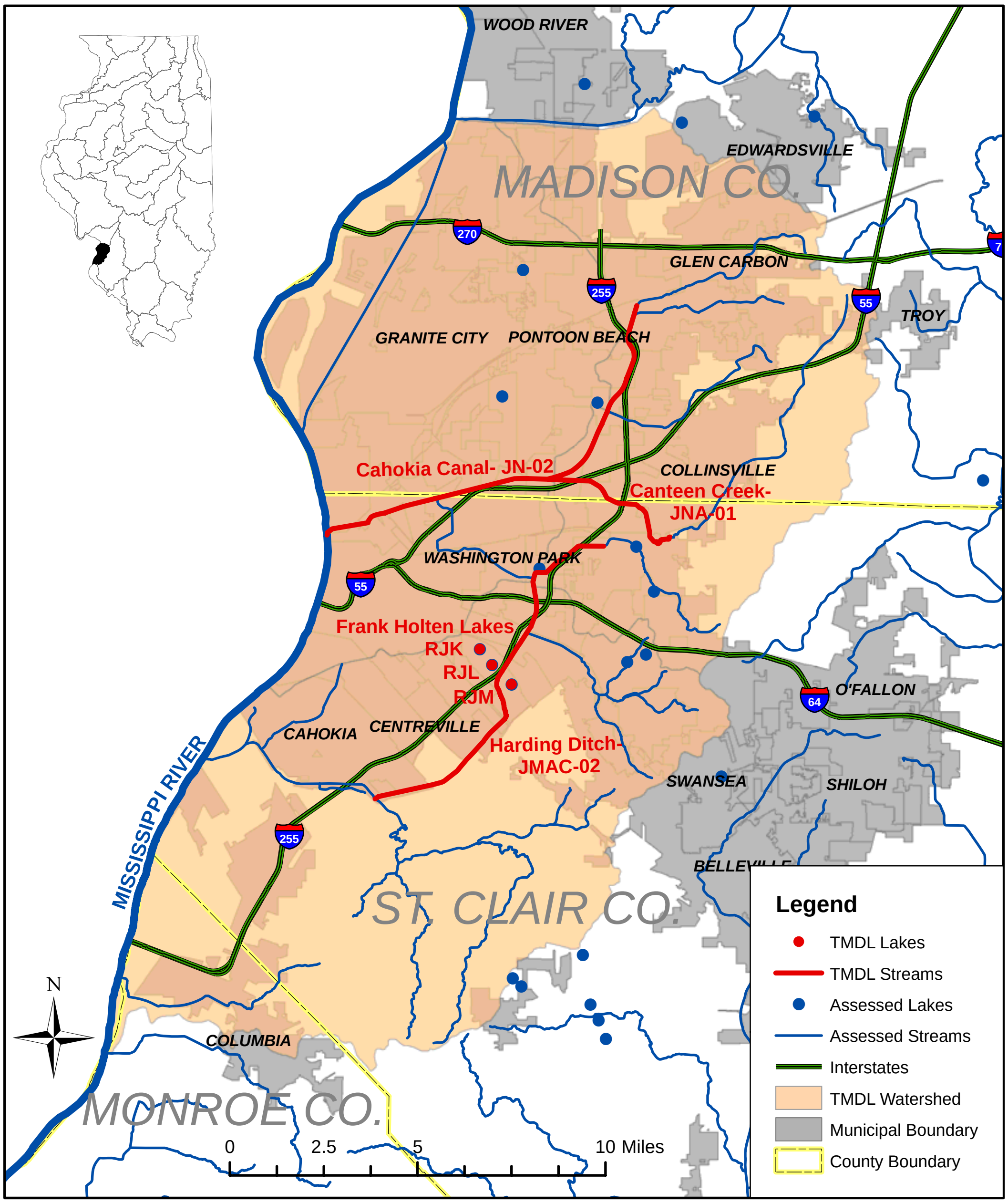
Illinois
Environmental
Protection Agency

Bureau of Water
P.O. Box 19276
Springfield, IL 62794-9276

August 2009

IEPA/BOW/09-001

Cahokia Canal Watershed TMDL Report



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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

AUG 20 2009

REPLY TO THE ATTENTION OF:

WW-16J

Marcia Willhite, Chief
Bureau of Water
Illinois Environmental Protection Agency
P.O. Box 19276
Springfield, Illinois 62794-9276

RECEIVED

AUG 26 2009

BUREAU OF WATER
BUREAU CHIEF'S OFF

Dear Ms. Willhite:

The U. S. Environmental Protection Agency has reviewed the final Total Maximum Daily Loads (TMDL) from the Illinois Environmental Protection Agency for the Cahokia Canal Watershed in Illinois. The TMDLs are for manganese, fecal coliform, and total phosphorus in Canteen Creek, Harding Ditch, and Frank Holten Lakes #1, #2, and #3, as discussed in the enclosure, and address the recreational use and aquatic life impairments in these waterbodies.

Based on this review, EPA has determined that Illinois's TMDLs meet the requirements of Section 303(d) of the Clean Water Act and EPA's implementing regulations at 40 C.F.R. Part 130. Therefore, EPA hereby approves 5 TMDLs in the Cahokia Canal Watershed in Illinois. The statutory and regulatory requirements, and EPA's review of Illinois's compliance with each requirement, are described in the enclosed decision document.

We wish to acknowledge Illinois's effort in submitting this TMDL and look forward to future TMDL submissions by the State of Illinois. If you have any questions, please contact Dean Maraldo, Acting Chief of the Watersheds and Wetlands Branch, at 312-353-2098.

Sincerely,

Tinka G. Hyde
Director, Water Division

Enclosure

cc: Jenny Clarke, IEPA

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CDM

Illinois Environmental Protection Agency

Cahokia Canal Watershed Total Maximum Daily Load

June 2009

Cahokia Canal at Prairie Road

Final Report

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Acronyms

°F	degrees Fahrenheit
ALMP	Ambient Lake Monitoring Program
BMP	best management practice
BOD	biochemical oxygen demand
$CBOD_5$	5-day carbonaceous biochemical oxygen demand
cfs	cubic feet per second
CRP	Conservation Reserve Program
CWA	Clean Water Act
DEM	Digital Elevation Model
DMR	Discharge Monitoring Reports
DO	dissolved oxygen
DP	dissolved phosphorus
ft	foot
GIS	geographic information system
GWLF	generalized watershed loading function
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
ICLP	Illinois Clean Lakes Program
IDA	Illinois Department of Agriculture
IDNR	Illinois Department of Natural Resources
ILLCP	Illinois Interagency Landscape Classification Project
Illinois EPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
ISWS	Illinois State Water Survey
LA	load allocation
LC	loading capacity
MBI	Macroinvertebrate Biotic Index
mg/L	milligrams per liter
MOS	margin of safety
NASS	National Agricultural Statistics Service
NCDC	National Climatic Data Center
NRCS	National Resource Conservation Service
PO_4	phosphate
SSURGO	Soil Survey Geographic Database

STATSGO	State Soil Geographic
STORET	Storage and Retrieval
TMDL	total maximum daily load
TP	total phosphorus
TSS	total suspended solids
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WLA	waste load allocation

Section 1
Goals and Objectives for Cahokia Canal Watershed (0714010105, 0714010106, 0714010104)

1.1 Total Maximum Daily Load (TMDL) Overview

A Total Maximum Daily Load, or TMDL, is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards. TMDLs are a requirement of Section 303(d) of the Clean Water Act (CWA). To meet this requirement, the Illinois Environmental Protection Agency (Illinois EPA) must identify water bodies not meeting water quality standards and then establish TMDLs for restoration of water quality. Illinois EPA lists water bodies not meeting water quality standards every two years. This list is called the 303(d) list and water bodies on the list are then targeted for TMDL development.

In general, a TMDL is a quantitative assessment of water quality problems, contributing sources, and pollution reductions needed to attain water quality standards. The TMDL specifies the amount of pollution or other stressor that needs to be reduced to meet water quality standards, allocates pollution control or management responsibilities among sources in a watershed, and provides a scientific and policy basis for taking actions needed to restore a water body.

Water quality standards are laws or regulations that states authorize to enhance water quality and protect public health and welfare. Water quality standards provide the foundation for accomplishing two of the principal goals of the CWA. These goals are:

- Restore and maintain the chemical, physical, and biological integrity of the nation's waters
- Where attainable, to achieve water quality that promotes protection and propagation of fish, shellfish, and wildlife, and provides for recreation in and on the water

Water quality standards consist of three elements:

- The designated beneficial use or uses of a water body or segment of a water body
- The water quality criteria necessary to protect the use or uses of that particular water body
- An antidegradation policy

Examples of designated uses are recreation and protection of aquatic life. Water quality criteria describe the quality of water that will support a designated use. Water quality criteria can be expressed as numeric limits or as a narrative statement.

Antidegradation policies are adopted so that water quality improvements are conserved, maintained, and protected.

1.2 TMDL Goals and Objectives for Cahokia Canal Watershed

The Illinois EPA has a three-stage approach to TMDL development. The stages are:

- Stage 1 – Watershed Characterization, Data Analysis, Methodology Selection
- Stage 2 – Data Collection (optional)
- Stage 3 – Model Calibration, TMDL Scenarios, Implementation Plan

This report addresses all stages of TMDL development for the Cahokia Canal watershed. Following are the impaired water body segments in the Cahokia Canal watershed for which a TMDL was developed:

- Cahokia Canal (JN 02)
- Harding Ditch (JMCA02)
- Frank Holten Main Lake (RJK)
- Frank Holten Lake #2 (RJL)
- Frank Holten Lake #3 (RJM)
- Canteen Creek (JNA 01)

These impaired water body segments are shown on Figure 1-1. There are six impaired segments within the Cahokia Canal watershed. Table 1-1 lists the water body segment, water body size, and potential causes of impairment for the water body. Originally the TMDL included Horseshoe Lake, but the Horseshoe Lake TMDL will be developed separately.

Table 1-1 Impaired Water Bodies in Cahokia Canal Watershed

Water Body Segment ID	Water Body Name	Size	Causes of Impairment with Numeric Water Quality Standards	Causes of Impairment with Assessment Guidelines
JN 02	Cahokia Canal	11.87 miles	Dissolved oxygen	Total nitrogen, sedimentation/siltation, habitat alterations (streams), total phosphorus
JMAA01	Prairie Du Pont Creek	14.34 miles	Dissolved oxygen[1]	Total phosphorus
JMAC02	Harding Ditch	10.48 miles	Total fecal coliform	
RJK	Frank Holten Main Lake	97 acres	Total phosphorus	TSS, excess algal growth, PCBs, total phosphorus
RJL	Frank Holten Lake #2	40 acres	Total phosphorus	TSS, excess algal growth, PCBs, total phosphorus
RJM	Frank Holten Lake #3	80 acres	Total phosphorus, dissolved oxygen	TSS, excess algal growth, non-native fish/animals, PCBs, total phosphorus
JNA 01	Canteen Creek	4.31 miles	Manganese	Total nitrogen, sedimentation/siltation, habitat alterations (streams), TSS, total phosphorus

[1] Data collected in 2003 indicates that Prairie Du Pont Creek is no longer impaired for dissolved oxygen and the segment will no longer be on the State's 303(d) list. Therefore, a TMDL for dissolved oxygen was not developed.

Illinois EPA is currently only developing TMDLs for parameters that have numeric water quality standards, and therefore the remaining sections of this report will focus on the manganese, dissolved oxygen, total phosphorus (numeric standard), pH, and total fecal coliform impairments in the Cahokia Canal watershed. For potential causes that do not have numeric water quality standards as noted in Table 1-1, TMDLs were not developed at this time. However, in the implementation plans completed during Stage 3 of the TMDL, many of these potential causes are addressed by implementation of controls for the pollutants with water quality standards. For example, when implementing best management practices for phosphorus in lakes, total suspended solids and excess algal growth may be reduced. Phosphorus adheres to soil particles and practices reducing soil erosion (nonpoint source controls) will reduce phosphorus. By reducing phosphorus, there will be less of this nutrient available for algal growth. Manganese is another impairment that can be related to soil erosion. Some areas of Illinois have soils naturally elevated with manganese. Best management practices to reduce manganese in streams may include nonpoint source controls designed to reduce soil erosion that will reduce other impairment such as phosphorus and sedimentation/ siltation.

The TMDL for the segments listed above will specify the following elements:

- Loading Capacity (LC) or the maximum amount of pollutant loading a water body can receive without violating water quality standards

- Waste Load Allocation (WLA) or the portion of the TMDL allocated to existing or future point sources
- Load Allocation (LA) or the portion of the TMDL allocated to existing or future nonpoint sources and natural background
- Margin of Safety (MOS) or an accounting of uncertainty about the relationship between pollutant loads and receiving water quality

These elements are combined into the following equation:

$$\mathbf{TMDL = LC = \Sigma WLA + \Sigma LA + MOS}$$

The TMDL developed took into account the seasonal variability of pollutant loads so that water quality standards are met during all seasons of the year. Also, reasonable assurance that the TMDL will be achieved is described in the implementation plan. The implementation plan for the Cahokia Canal watershed (Section 9) describes how water quality standards will be attained. This implementation plan includes recommendations for implementing best management practices (BMPs), cost estimates, institutional needs to implement BMPs and controls throughout the watershed, and a timeframe for completion of implementation activities.

1.3 Report Overview

The remaining sections of this report contain:

- **Section 2 Cahokia Canal Watershed Characteristics** provides a description of the watershed's location, topography, geology, land use, soils, population, and hydrology.
- **Section 3 Public Participation and Involvement** discusses public participation activities that occurred throughout the TMDL development.
- **Section 4 Cahokia Canal Watershed Water Quality Standards** defines the water quality standards for the impaired water body.
- **Section 5 Cahokia Canal Watershed Characterization** presents the available water quality data needed to develop TMDLs, discusses the characteristics of the impaired reservoirs in the watershed, and also describes the point and non-point sources with potential to contribute to the watershed load.
- **Section 6 Approach to Developing TMDL and Identification of Data Needs** made recommendations for the models and analysis that were used for TMDL development and also suggested segments for Stage 2 data collection.
- **Section 7 Model Development for the Cahokia Canal Watershed** provides an explanation of modeling tools used to develop TMDLs for impaired segments and potential causes of impairments within the watershed.

- **Section 8 Total Maximum Daily Loads for the Cahokia Canal Watershed** discusses the calculated allowable loadings to water bodies in order to meet water quality standards and the reductions in existing loadings needed to meet the determined allowable loads.
- **Section 9 Implementation Plan** includes recommendations for implementing BMPs and continued monitoring throughout the watershed
- **Section 10 References**

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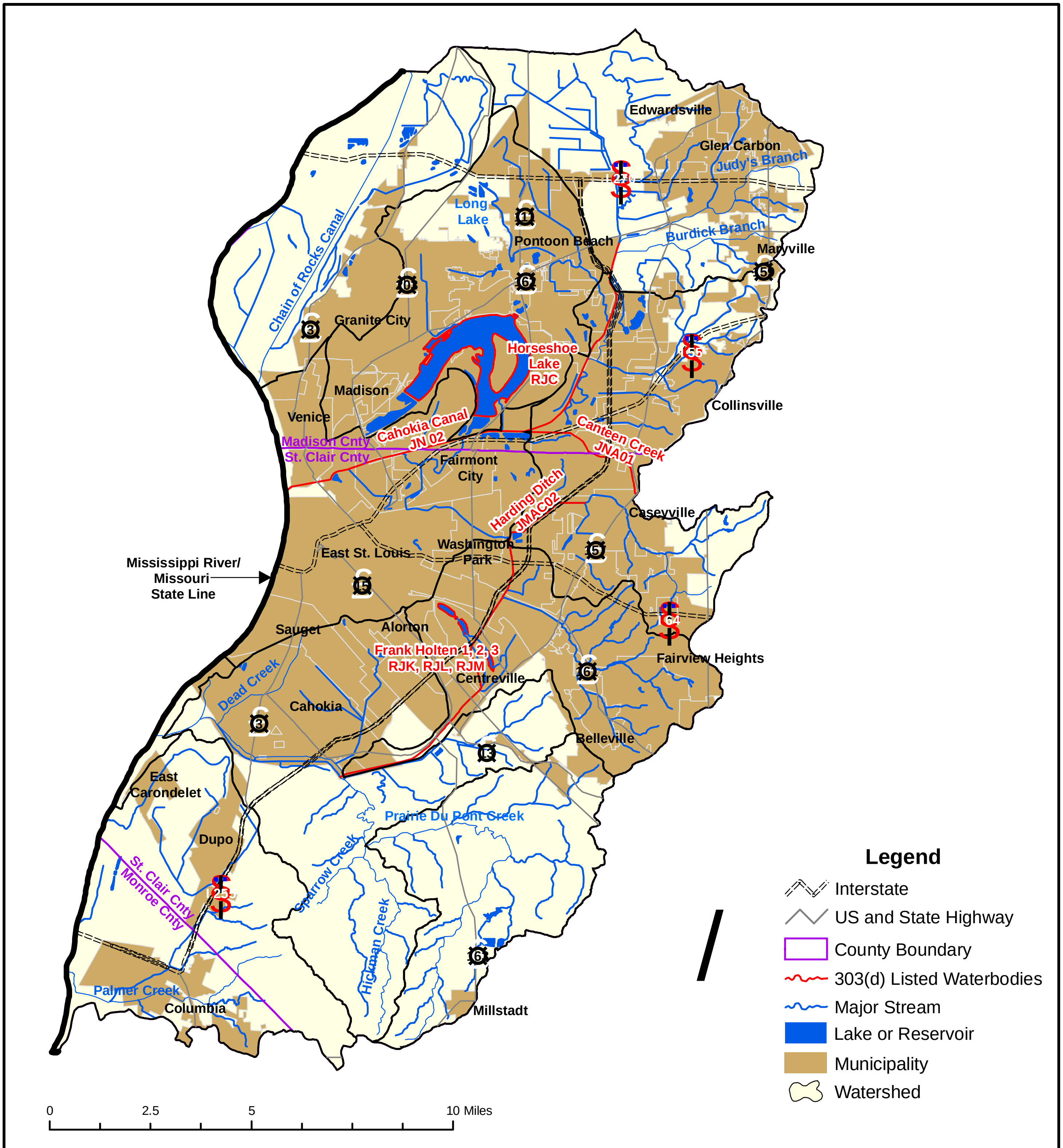

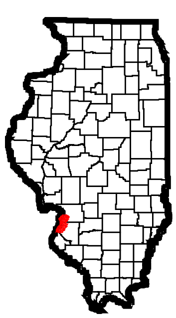

Figure 1-1
Cahokia Canal/Horseshoe Lake Watershed

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Section 2
Cahokia Canal Watershed Description

2.1 Cahokia Canal Watershed Location

The Cahokia Canal watershed (Figure 1-1) is located in southern Illinois, flows in a southwesterly direction, and drains approximately 181,673 acres within the state of Illinois. Approximately 75,472 acres lie in southwestern Madison County, 97,427 acres lie in western St. Clair County, and 8,775 acres lie in northern Monroe County.

2.2 Topography

Topography is an important factor in watershed management because stream types, precipitation, and soil types can vary dramatically by elevation. National Elevation Dataset (NED) coverages containing 30-meter grid resolution elevation data are available from the U.S. Geological Survey (USGS) for each 1:24,000-topographic quadrangle in the United States. Elevation data for the Cahokia Canal watershed was obtained by overlaying the NED grid onto the GIS-delineated watershed. Figure 2-1 shows the elevations found within the watershed.

Elevation in the Cahokia Canal watershed ranges from 702 feet above sea level in the headwaters of Cahokia Canal to 374 feet at its most downstream point at the Mississippi River. The absolute elevation change is 26 feet over the approximately 12-mile stream length of Cahokia Canal, which yields a stream gradient of approximately 2.2 feet per mile. Prairie DuPont Creek, located in the southern half of the watershed, yields an absolute elevation change of 262 feet over the approximately 20-mile stream length and a stream gradient of approximately 13.3 feet per mile.

2.3 Land Use

Land use data for the Cahokia Canal watershed were extracted from the Illinois Gap Analysis Project (IL-GAP) Land Cover data layer. IL-GAP was started at the Illinois Natural History Survey (INHS) in 1996, and the land cover layer was the first component of the project. The IL-GAP Land Cover data layer is a product of the Illinois Interagency Landscape Classification Project (IILCP), an initiative to produce statewide land cover information on a recurring basis cooperatively managed by the United States Department of Agriculture National Agricultural Statistics Service (NASS), the Illinois Department of Agriculture (IDA), and the Illinois Department of Natural Resources (IDNR). The land cover data was generated using 30-meter grid resolution satellite imagery taken during 1999 and 2000. The IL-GAP Land Cover data layer contains 23 land cover categories, including detailed classification in the vegetated areas of Illinois. Appendix A contains a complete listing of land cover categories. (Source: IDNR, INHS, IDA, USDA NASS's 1:100,000 Scale Land Cover of Illinois 1999-2000, Raster Digital Data, Version 2.0, September 2003.)

The land use of the Cahokia Canal watershed was determined by overlaying the IL-GAP Land Cover data layer onto the GIS-delineated watershed. Table 2-1 contains the land uses contributing to the Cahokia Canal watershed, based on the IL-GAP land cover categories and also includes the area of each land cover category and percentage of the watershed area. Figure 2-2 illustrates the land uses of the watershed.

The land cover data reveal that approximately 73,373 acres, representing nearly 40 percent of the total watershed area, are devoted to agricultural activities. Corn and soybean farming account for nearly 13 percent and 15 percent of the watershed area, respectively. Urban areas occupy approximately 33 percent of the watershed (about nine percent high density, 17 percent low/medium density, and eight percent urban open space). Upland forests occupy approximately 11 percent of the watershed, and urban open space and wetlands each occupy approximately eight percent. Other land cover categories represent five percent or less of the watershed area.

Table 2-1 Land Use in Cahokia Canal Watershed

Land Cover Category	Area (Acres)	Percentage
Corn	22,892	12.6%
Soybeans	27,284	15.0%
Winter Wheat	3,554	2.0%
Other Small Grains & Hay	552	0.3%
Winter Wheat/Soybeans	7,651	4.2%
Other Agriculture	2,440	1.3%
Rural Grassland	9,000	5.0%
Upland	19,385	10.7%
Forested Areas	5,283	2.9%
High Density	15,606	8.6%
Low/Medium Density	30,259	16.7%
Urban Open Space	14,126	7.8%
Wetlands	14,213	7.8%
Surface Water	8,591	4.7%
Barren & Exposed Land	837	0.4%
Total	**181,673**	**100%**

1. Forested areas include partial canopy/savannah upland.
2. Wetlands include shallow marsh/wet meadow, deep marsh, seasonally/temporally flooded, floodplain forest, and shallow water.

2.4 Soils

Soils information is important in TMDL development because soil type can affect watershed drainage and may contribute to elevated concentrations of pollutants such as manganese. Historic soil surveys for Madison, Monroe and St Clair Counties were obtained from the NRCS. In addition, detailed soils data and spatial coverages are available through the Soil Survey Geographic (SSURGO) database for a limited number of counties in Illinois. For SSURGO data, field mapping methods using national standards are used to construct the soil maps. Mapping scales generally range from 1:12,000 to 1:63,360 making SSURGO the most detailed level of NRCS soil mapping.

The Cahokia Canal watershed falls within Madison, Monroe, and St. Clare Counties. Figure 2-3 displays the SSURGO soil series in the Cahokia Canal watershed. Attributes of the spatial coverage can be linked to the SSURGO database, which provides information on various chemical and physical soil characteristics for each map unit and soil series. Of particular interest for TMDL development are the hydrologic soil groups as well as the K-factor of the Universal Soil Loss Equation. The following sections describe and summarize the specified soil characteristics for the Cahokia Canal watershed.

2.4.1 Cahokia Canal Watershed Soil Characteristics

Appendix B contains the SSURGO soil series for the Cahokia Canal watershed. The table also contains the area, dominant hydrologic soil group, and k-factor range. Each of these characterizations is described in more detail in the following paragraphs. The predominant soil type in the watershed is Darwin Silty Clay on zero to 2 percent slopes followed by Marine Silt Loam on 0 to 5 percent slopes. According to the Madison County Soil Survey (NRCS, 2004), the Darwin Soil Series is slightly acidic with “masses of iron-manganese accumulation” below 10 inches and the Marine Soil Series is strongly acid with “iron-manganese nodules” throughout.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils are assigned to one of four groups. They are grouped according to their infiltration rates under saturated conditions during long duration storm events. All four hydrologic soil groups (A, B, C, and D) are found within the Cahokia Canal watershed with the majority of the watershed falling into category B. Category B soils are defined as "soils having a moderate infiltration rate when thoroughly wet." Category B soils "consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture." These soils have a moderate rate of water transmission. (NRCS, 2005)

A commonly used soil attribute is the K-factor. The K-factor:

> *Indicates the susceptibility of a soil to sheet and rill erosion by water.* (The K-factor) *is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion. Losses are expressed in tons per acre per year. These estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water (NRCS 2005).*

The distribution of K-factor values in the Cahokia Canal watershed range from 0.02 to 0.55.

2.5 Population

Population data were retrieved from Census 2000 TIGER/Line Data from the U.S. Bureau of the Census. Geographic shape files of census blocks were downloaded for every county containing any portion of the watersheds. The block files were clipped to each watershed so that only block populations associated with the watershed would be counted. The census block demographic text file (PL94) containing population data was downloaded and linked to each watershed and summed. City populations were taken from the U.S. Bureau of the Census. For municipalities that are located across watershed borders, the population was estimated based on the percentage of area of municipality within the watershed boundary.

Approximately 226,747 people reside in the watershed. The major municipalities in the Cahokia Canal watershed are shown in Figure 1-1. The cities of Granite City, East St. Louis, Collinsville, and Cahokia are the largest population centers in the watershed and contribute an estimated 31,301, 22,638, 16,455, and 16,391 people, respectively, to total watershed population.

2.6 Climate and Streamflow

2.6.1 Climate

Southern Illinois has a temperate climate with hot summers and cold, snowy winters. Monthly precipitation and temperature data were available for the Cahokia station (id. 1160) in St. Clair County and were extracted from the NCDC database. Data were available from 1969-2002. Cahokia, Illinois is located within the basin and was chosen to be representative of meteorological conditions throughout the Cahokia Canal watershed.

Table 2-2 contains the average monthly precipitation along with average high and low temperatures for the period of record. The average annual precipitation is approximately 39 inches.

Table 2-2 Average Monthly Climate Data in Cahokia, IL

Month	Total Precipitation (inches)	Maximum Temperature (degrees F)	Minimum Temperature (degrees F)
January	2.1	39	20
February	2.3	45	25
March	3.6	56	34
April	4.0	68	45
May	4.0	76	54
June	3.8	85	63
July	3.8	89	67
August	3.6	87	65
September	3.1	80	57
October	2.7	70	45
November	3.5	56	35
December	2.7	44	26
Total	**39.2**		

2.6.2 Streamflow

Analysis of the Cahokia Canal watershed requires an understanding of flow throughout the drainage area. Unfortunately, there are no USGS gages within the watershed that have current, or even recent, streamflow data. Streamflow data for this TMDL were estimated through the drainage area ratio method which assumes that the flow per unit area is equivalent in watersheds with similar characteristics. This analysis is further described in Section 7 of this report.

2.7 Watershed Photographs

The photographs shown here are of the Cahokia Canal watershed that were taken in the fall of 2006. Appendix D contains additional photographs of the watershed.

Cahokia Canal at Route 162 Looking South

Cahokia Canal at Route 162 Looking North

Harding Ditch at Bunkham Road Looking North

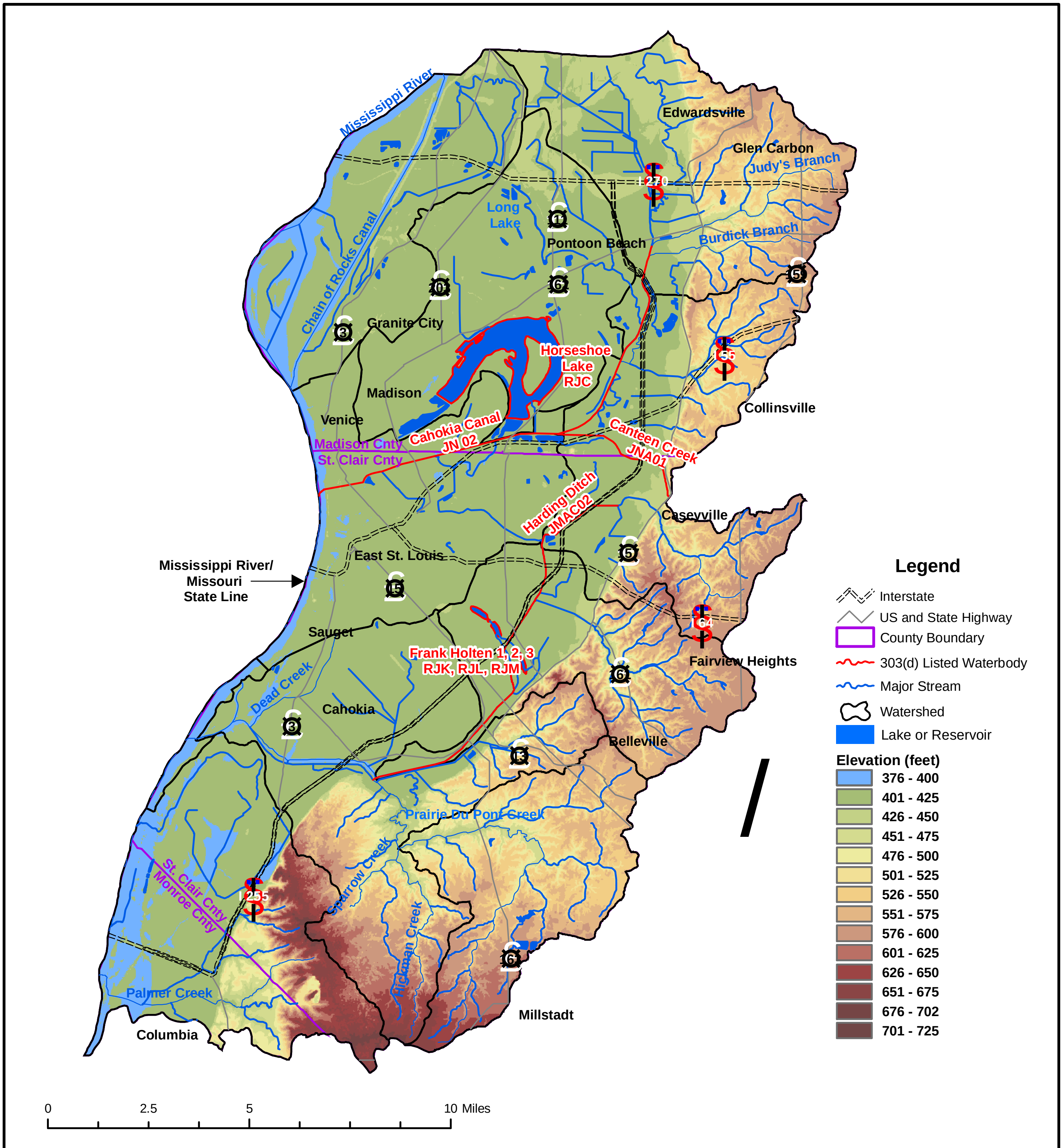
Canteen Creek at Sand Prairie Road Looking West

Frank Holten Lake #1 Looking Northwest Toward Saint Louis

Frank Holten Lake #2 Looking Northwest

Frank Holten Lake #3

Canteen Creek Southeast of Bluff Road Looking West



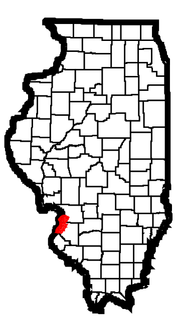


Figure 2-1
Cahokia Canal/Horseshoe Lake Watershed
Elevation

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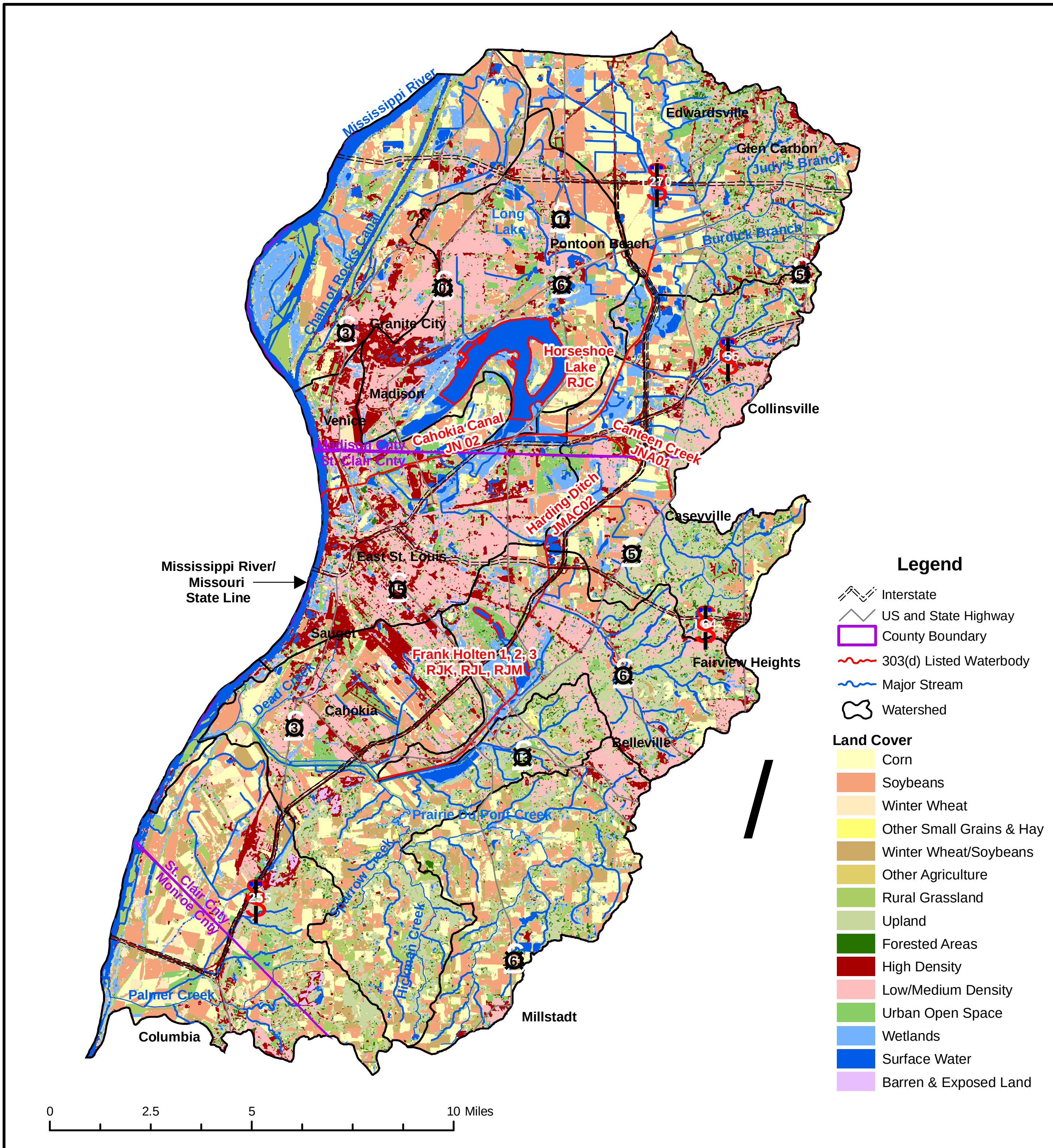

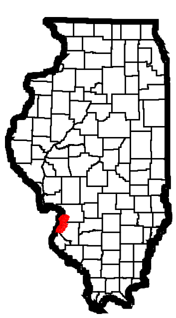

Figure 2-2
Cahokia Canal/Horseshoe Lake Watershed
Land Use

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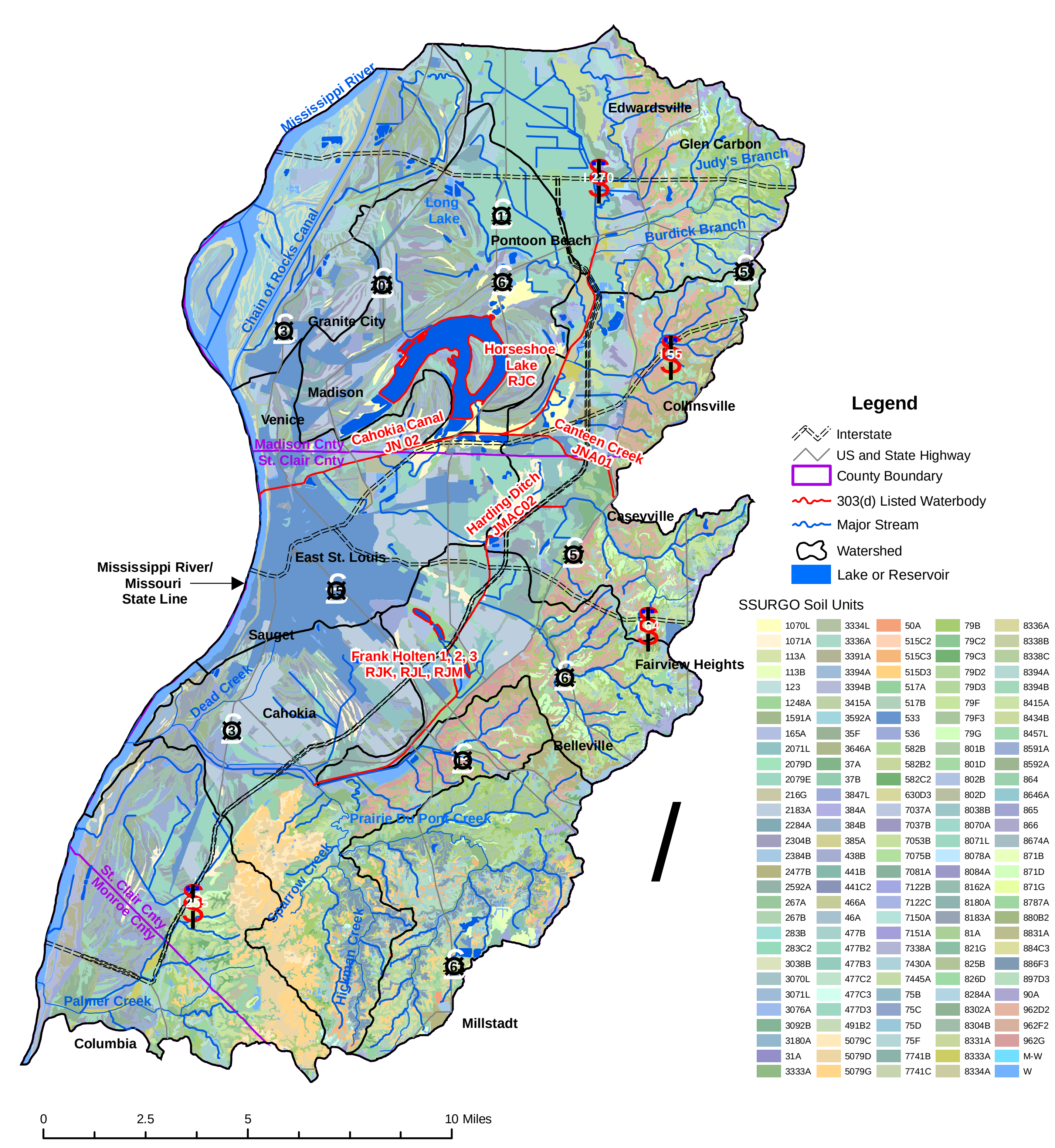

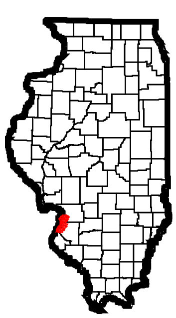

Figure 2-3
Cahokia Canal/Horseshoe Lake Watershed
Soils

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Section 3
Public Participation and Involvement

3.1 Cahokia Canal Watershed Public Participation and Involvement

Public knowledge, acceptance, and follow through are necessary to implement a plan to meet recommended TMDLs. It is important to involve the public as early in the process as possible to achieve maximum cooperation and counter concerns as to the purpose of the process and the regulatory authority to implement any recommendations.

Illinois EPA, along with CDM, held two public meetings within the watershed throughout the course of the TMDL development. Public meetings were held on June 29, 2006 at IDOT District 8 Headquarters in Collinsville, Illinois to present Stage 1 of TMDL development for the Cahokia Canal watershed and on March 27, 2008 to present Stage 3 TMDL results.

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Section 4
Cahokia Canal Watershed Water Quality Standards

4.1 Illinois Water Quality Standards

Water quality standards are developed and enforced by the state to protect the "designated uses" of the state's waterways. In the state of Illinois, setting the water quality standards is the responsibility of the Illinois Pollution Control Board (IPCB). Illinois is required to update water quality standards every three years in accordance with the CWA. The standards requiring modifications are identified and prioritized by Illinois EPA, in conjunction with USEPA. New standards are then developed or revised during the three-year period.

Illinois EPA is also responsible for developing scientifically based water quality criteria and proposing them to the IPCB for adoption into state rules and regulations. The Illinois water quality standards are established in the Illinois Administrative Rules Title 35, Environmental Protection; Subtitle C, Water Pollution; Chapter I, Pollution Control Board; Part 302, Water Quality Standards.

4.2 Designated Uses

The waters of Illinois are classified by designated uses, which include: General Use, Public and Food Processing Water Supplies, Lake Michigan, and Secondary Contact and Indigenous Aquatic Life Use (Illinois EPA 2005). General Use is the only applicable designated use within the Cahokia Canal watershed.

4.2.1 General Use

All TMDL waters in the Cahokia Canal watershed are classified as general use waters. The General Use classification is defined by IPCB as standards that will protect the state's water for aquatic life, wildlife, agricultural use, secondary contact use and most industrial uses and ensure the aesthetic quality of the state's aquatic environment. Primary contact uses are protected for all General Use waters whose physical configuration permits such use.

4.3 Illinois Water Quality Standards

Table 4-1 contains information on the specific impaired uses, causes of impairment and potential pollutant sources while tables 4-2 and 4-3 present the applicable water quality standards for TMDL development for both lakes and streams within the Cahokia Canal watershed. Only constituents with numeric water quality standards will have TMDLs developed at this time.

Table 4-1: Summary of Impaired Uses, Causes and Potential Sources for Cahokia Canal Watershed

Segment ID	Segment Name	Impaired Use	Impairment Cause	Potential Sources of Impairment
JN-02	Cahokia Canal	Aquatic Life	Total nitrogen as N, sedimentation/siltation, **DO**, habitat alterations, phosphorus (total)	Agriculture, crop-related sources, nonirrigated crop production, construction, land development, urban runoff/storm sewers, hydromodification, channelization, source unknown
JNA-01	Canteen Cr.	Aquatic Life	**Manganese**, Phosphorus (Total), TSS, sedimentation/siltation, habitat alterations	Municipal point sources, agriculture, crop-related sources, nonirrigated crop production, construction, land development, urban runoff/storm sewers, hydromodification, channelization, source unknown
JMAC-02	Harding Ditch	Primary Contact Recreation	**Fecal Coliform**	Source unknown
RJK	Frank Holten Lake 1	Aesthetic Quality	**Phosphorus (Total),** TSS, excessive algal growth	Urban runoff/storm sewers, land disposal, onsite wastewater systems (septic tanks), recreation and tourism activities (other than boating), source unknown
		Fish Consumption	Polychlorinated biphenyls	
RJL	Frank Holten Lake 2	Aesthetic Quality	**Phosphorus (Total),** TSS, excessive algal growth	Urban runoff/storm sewers, land disposal, onsite wastewater systems (septic tanks), recreation and tourism activities (other than boating), source unknown
		Fish Consumption	Polychlorinated biphenyls	
RJM	Frank Holten Lake 3	Aesthetic Quality	**Phosphorus (Total),** TSS, excessive algal growth	Urban runoff/storm sewers, land disposal, onsite wastewater systems (septic tanks), other, source unknown
		Aquatic Life	**Phosphorus (Total),** TSS, **DO**, non-native fish/animals	
		Fish Consumption	Polychlorinated biphenyls	

Impairment Causes in Bold Type are those that have numeric water quality standards for which TMDLs were developed

Table 4-2 Summary of Water Quality Standards for Cahokia Canal Watershed Lake TMDL Impairments

Parameter	Units	General Use Water Quality Standard
Total Phosphorus	mg/L	0.05[1]
Oxygen, Dissolved	mg/L	5.0 instantaneous minimum;
		6.0 minimum during at least 16 hours of any 24 hour period

mg/L = milligrams per liter NA
1. Standard applies in particular inland lakes and reservoirs (greater than 20 acres) and in any stream at the point where it enters any such lake or reservoir.

Table 4-3 Summary of Water Quality Standards for Cahokia Canal Watershed Stream TMDL Impairments

Parameter	Units	General Use Water Quality Standard
Manganese	µg/L	1000
Oxygen, Dissolved	mg/L	5.0 instantaneous minimum;
		6.0 minimum during at least 16 hours of any 24 hour period
Total Fecal Coliform	Count/ 100 mL	May through Oct – 200[(1)], 400[(2)]
		Nov though Apr – no numeric standard

µg/L = micrograms per mg/L = milligrams per
(1) Geometric mean based on a minimum of 5 samples taken over not more than a 30 day period
(2) Standard shall not be exceeded by more than 10% of the samples collected during any 30 day period

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Section 5
Cahokia Canal Watershed Characterization

Data were collected and reviewed from many sources in order to further characterize the Cahokia Canal Watershed. Data has been collected for water quality, reservoirs, and both point and nonpoint sources. This information is presented and discussed in further detail in the remainder of this section.

5.1 Water Quality Data

There are 14 historic water quality stations within the Cahokia Canal watershed that were used for this report. Figure 5-1 shows the water quality data stations within the watershed that contain data relevant to the impaired segments.

The impaired water body segments in the Cahokia Canal watershed were presented in Section 1. Refer to Table 1-1 for impairment information specific to each segment. The following sections address both stream and lake impairments. Data are summarized by impairment and discussed in relation to the relevant Illinois numeric water quality standard. Data analysis is focused on all available data collected since 1990. The information presented in this section is a combination of USEPA Storage and Retrieval (STORET) database and Illinois EPA database data. STORET data is available for stations sampled prior to January 1, 1999 while Illinois EPA data (electronic and hard copy) are available for stations sampled after that date. The following sections will first discuss Cahokia Canal watershed stream data followed by Cahokia Canal watershed lake/reservoir data.

5.1.1 Stream Water Quality Data

The Cahokia Canal watershed has four impaired streams within its drainage area that are addressed in this report. There are five active water quality stations on impaired segments (see Figure 5-1). The data summarized in this section include water quality data for impaired constituents as well as parameters that could be useful in future modeling and analysis efforts. All historic data is available in Appendix C.

5.1.1.1 Fecal Coliform

Segment JMAC02 of Harding Ditch is listed as impaired for total fecal coliform. Table 5-1 summarizes available historic fecal coliform data on the segment. The general use water quality standard for fecal coliform states that the standard of 200 per 100 mL not be exceeded by the geometric mean of at least five samples, nor can 10 percent of the samples collected exceed 400 per 100 mL in protected waters, except as provided in 35 Ill. Adm. Code 302.209(b). Samples must be collected over a 30 day period or less during peak fecal coliform application periods (May through October).

There are no instances since 1990 where at least five samples have been collected during a 30-day period. The summary of data presented in Table 5-1 reflects single samples compared to the standards during the appropriate months. Figure 5-2 shows the total fecal coliform samples collected over time on the impaired segment. Data is limited on the segment because samples collected between 1997 and 2003 were omitted due to exceeding the holding time.

Table 5-1 Existing Fecal Coliform Data for Harding Ditch JMAC02

Sample Location and Parameter	Period of Record and Number of Data Points	Geometric mean of all samples	Maximum	Minimum	Number of samples > 200 [1]	Number of samples > 400 [1]
Harding Ditch Segment JMAC02; Sample Location JMAC02						
Total Fecal Coliform (cfu/100 mL)	1990-2004; 73	2,028	20,000	165	37	34

(1) Samples collected during the months of May through October

5.1.1.2 Dissolved Oxygen

Segment JN02 of Cahokia Canal and JMAA01 of Prairie Du Pont Creek are currently listed as impaired for dissolved oxygen (DO). Recent data collected on segment JMAA01 show that a DO impairment no longer exists. In the summer of 2005 three-day continuous DO monitoring data was taken at half-hour intervals on three different locations on the stream segment. There were no violations in this data, and therefore, this segment will be delisted for DO in the future when new assessments are made. Table 5-2 summarizes the available historic DO data since 1990 for Segment JN02 of Cahokia Canal (raw data contained in Appendix C). The table also shows the number of violations recorded on the segment. A sample was considered a violation if it was below 5.0 mg/L. Figure 5-3 shows the instantaneous DO concentrations over time on the Cahokia Canal.

Table 5-2 Existing Dissolved Oxygen Data for Cahokia Canal JN02

Sample Location and Parameter	Illinois WQ Standard (mg/L)	Period of Record and Number of Data Points	Mean	Maximum	Minimum	Number of Violations
Cahokia Canal Segment JN02; Sample Location JN02						
DO	5.0[1]	1990-2003; 126	8.2	13.9	2.3	16

(1) Instantaneous Minimum

Table 5-3 contains information on data availability for other parameters that may be useful in data needs analysis and future modeling efforts for DO. Where available, all nutrient, biological oxygen demand (BOD), and total organic carbon data has been collected for possible use in future analysis.

Table 5-3 Data Availability for DO Data Needs Analysis and Future Modeling Efforts

Sample Location and Parameter	Available Period of Record Post 1990	Number of Samples
Cahokia Canal Segment JN02; Sample Location JN02		
Ammonia, Unionized (Calc Fr Temp-pH-NH4) (mg/L)	1990-1998	82
Ammonia, Unionized (mg/L as N)	1990-1998	82
BOD, 5-Day, 20 Deg C (mg/L)	1990	1
Carbon, Total Organic (mg/L as C)	1998	2
COD, .025N K2CR2O7 (mg/L)	1990-1993	36
Nitrite plus Nitrate, Total 1 Det. (mg/L as N)	1990-2002	115
Nitrogen, Ammonia, Total (mg/L as N)	1990-2002	115
Nitrogen, Kjeldahl, Total (mg/L as N)	1998-2002	26
Phosphorus, Dissolved (mg/L as P)	1990-2002	115
Phosphorus, Total (mg/L as P)	1990-2002	115

5.1.1.3 Manganese

Segment JNA01 of Canteen Creek is impaired for manganese. The applicable water quality standard is a maximum total manganese concentration of 1,000 µg/L. Table 5-4 summarizes the available historic manganese data since 1990 for the impaired stream. The table also shows the number of violations recorded on the segment. Figure 5-4 shows total manganese values recorded over time for Canteen Creek.

Table 5-4 Existing Manganese Data for Canteen Creek JNA01

Sample Location and Parameter	Illinois WQ Standard (µg/L)	Period of Record and Number of Data Points	Mean	Maximum	Minimum	Number of Violations
Canteen Creek Segment JNA01; Sample Locations JNA01 and JNA02						
Total Manganese (µg/L)	General Use: 1000	1990-1998; 83	423	3,800	68	2

5.1.2 Lake and Reservoir Water Quality Data

The Cahokia Canal watershed has four impaired lakes within its drainage area that are addressed in this report. There are nine active water quality stations on or tributary to the impaired water bodies (see Figure 5-1). The data summarized in this section include water quality data for impaired constituents as well as parameters that could be useful in future modeling and analysis efforts. All historic data is available in Appendix C.

5.1.2.1 Frank Holten Lakes 1, 2, and 3

There are five active stations on the Frank Holten Lakes. The lakes are impaired for total phosphorus and Lake 3 is also impaired for DO. An inventory of all available phosphorus data for each lake as well as DO data for Lake 3 at all depths is presented in Table 5-5.

Table 5-5 Frank Holten Lakes - Data Inventory for Impairments

Frank Holten Lakes 1, 2, and 3 – Segments RJK, RJL, and RJM		
RJK-1	**Period of Record**	**Number of Samples**
Total Phosphorus	1990-2002	89
Dissolved Phosphorus	1990-2002	88
RJL-1		
Total Phosphorus	1990-2002	104
Dissolved Phosphorus	1990-2002	88
Total Phosphorus in Bottom Deposits	1992-1996	3
RJM-1		
Total Phosphorus	1990-2002	110
Dissolved Phosphorus	1990-2002	66
Total Phosphorus in Bottom Deposits	1992-1996	3
Dissolved Oxygen	1990-2002	216
RJM-2		
Total Phosphorus	1990-2002	47
Dissolved Phosphorus	1990-2002	43
Dissolved Oxygen	1990-2002	209
RJM-3		
Total Phosphorus	1990-2002	55
Dissolved Phosphorus	1990-2002	43
Total Phosphorus in Bottom Deposits	1992-1996	2
Dissolved Oxygen	1990-2002	179

Table 5-6 contains information on data availability for other parameters that may be useful in data needs analysis and future modeling efforts for total phosphorus and DO. DO and chlorophyll-a data has been collected where available for phosphorus impairments while nutrient data has been collected for the DO impairment.

Table 5-6 Frank Holten Lakes -Data Availability for Data Needs Analysis and Future Modeling Efforts

Frank Holten Lakes 1, 2, and 3 – Segments RJK, RJL, and RJM		
RJK-1	**Period of Record**	**Number of Samples**
Chlorophyll-a Corrected	1996-2002	29
Chlorophyll-a Uncorrected	1996-2002	29
Total Depth	1990-1998	51
Dissolved Oxygen	1999-2002	80
Temperature	1992-2002	81
RJL-1		
Chlorophyll-a Corrected	1990-2002	42
Chlorophyll-a Uncorrected	1990-2002	42
Depth of Pond or Reservoir in Feet	1990-1996	99
Oxygen, Dissolved, Analysis by Probe (mg/L)	1999-2002	115
Temperature	1990-2002	527
RJM-1		
Ammonia, Unionized (Calc Fr Temp-pH-NH4) (mg/L)	1990-1996	40
Ammonia, Unionized (mg/L as N)	1990-1996	40
Chlorophyll-a Corrected	1990-2002	42
Chlorophyll-a Uncorrected	1990-2002	42
COD, .025N K2CR2O7 (mg/L)	1990-1992	50
Depth of Pond or Reservoir in Feet	1990-1998	92
Nitrite plus Nitrate, Total 1 Det. (mg/L as N)	1990-1996	92
Nitrogen, Ammonia, Total (mg/L as N)	1990-1996	91
Nitrogen, Kjeldahl, Total (mg/L as N)	1990-1996	73

Table 5-6 Frank Holten Lakes -Data Availability for Data Needs Analysis and Future Modeling Efforts (continued)

Frank Holten Lakes 1, 2, and 3 – Segments RJK, RJL, and RJM		
RJM-1 (continued)	**Period of Record**	**Number of Samples**
Dissolved Oxygen, % of Saturation	1990-1996	172
Temperature	1990-2002	216
RJM-2		
Ammonia, Unionized (Calc Fr Temp-pH-NH4) (mg/L)	1990-1996	33
Ammonia, Unionized (mg/L as N)	1990-1996	33
Chlorophyll-a Corrected	1990-2002	44
Chlorophyll-a Uncorrected	1990-2002	44
COD, .025N K2CR2O7 (mg/L)	1990-1992	28
Depth of Pond or Reservoir in Feet	1990-1998	81
Nitrite plus Nitrate, Total 1 Det. (mg/L as N)	1990-1996	37
Nitrogen, Ammonia, Total (mg/L as N)	1990-1996	37
Nitrogen, Kjeldahl, Total (mg/L as N)	1990-1996	33
Dissolved Oxygen, % of Saturation	1990-1996	169
Temperature	1990-2002	209
RJM-3		
Ammonia, Unionized (Calc Fr Temp-pH-NH4) (mg/L)	1990-1996	33
Ammonia, Unionized (mg/L as N)	1990-1996	33
Chlorophyll-a Corrected	1990-2002	42
Chlorophyll-a Uncorrected	1990-2002	42
COD, .025N K2CR2O7 (mg/L)	1990-1992	28
Depth of Pond or Reservoir in Feet	1990-2002	81
Nitrite plus Nitrate, Total 1 Det. (mg/L as N)	1990-1996	45
TKN Bottom Deposits	1992-1996	2
Nitrogen, Ammonia, Total (mg/L as N)	1990-1996	45
Nitrogen, Kjeldahl, Total (mg/L as N)	1990-1996	33
Dissolved Oxygen, % of Saturation	1990-1996	153
Temperature	1990-2002	179

5.1.2.1.1 Total Phosphorus

The average total phosphorus concentrations at a one-foot depth for each year of available data at each monitoring site in the Frank Holten Lakes are presented in Table 5-7. The water quality standard for total phosphorus is a concentration less than or equal to 0.05 mg/L and compliance is assessed at a one-foot depth from the lake surface.

Table 5-7 Average Total Phosphorus Concentrations (mg/L) in the Frank Holten Lakes at One-Foot Depth

Year	**RJK-1**		**RJL-1**		**RJM-1**		**RJM-2**		**RJM-3**	
	Data Count; No. of Violations	**Mean**	**Data Count; No. of Violations**	**Mean**	**Data Count; No. of Violations**	**Mean**	**Data Count; No. of Violations**	**Mean**	**Data Count; No. of Violations**	**Mean**
1990	21; 21	0.44	16; 15	0.14	32; 32	0.15	12; 12	0.15	12; 12	0.17
1991	7; 7	0.20	23; 23	0.16	25; 25	0.17	11; 11	0.15	23; 23	0.19
1992	24; 24	0.37	8; 8	0.15	19; 19	0.16	8; 8	0.11	5; 5	0.16
1996	6; 5	0.11	5; 5	0.15	5; 5	0.16	6; 6	0.17	5; 5	0.22
1997	6; 6	0.16	NA	NA	NA	NA	NA	NA	NA	NA
1998	5; 5	0.15	NA	NA	NA	NA	NA	NA	NA	NA
1999	5; 5	0.06	5; 5	0.06	5; 5	0.10	5; 5	0.11	5; 5	0.12
2002	5; 5	0.14	5; 5	0.15	5; 5	0.21	5; 5	0.23	5; 5	0.26

Only one sample collected was below the phosphorus standard on both Frank Holten Lake 1 (RJK) and 2 (RJL). No samples have been below the 0.05 mg/L total phosphorus standard on Frank Holten Lake 3 (RJM). Figure 5-7 shows the annual average total phosphorus concentrations for each sampling location on each lake. Average concentrations were highest in Frank Holten Lake 1 in 1990, in Frank Holten Lake 2 in 1991, and in Frank Holten Lake 3 in 2002.

5.1.2.1.2 DO

The average DO concentrations at a one-foot depth for each year of available data at each monitoring site on Frank Holten Lake #3 are presented in Table 5-8. The water quality standard for DO is an instantaneous minimum concentration of 5.0 mg/L. Compliance is determined at a one-foot depth from the lake surface.

Table 5-8 Average Dissolved Oxygen Concentrations (mg/L) in Frank Holten Lake #3 at One-Foot Depth

	RJM-1		RJM-2		RJM-3		Lake Average	
Year	Data Count; No. of Violations	Mean	Data Count; No. of Violations	Mean	Data Count; No. of Violations	Mean	Data Count; No. of Violations	Mean
1990	12; 0	9.9	12; 0	10.0	12; 0	9.9	36; 0	9.9
1991	11; 0	11.2	11; 0	11.0	11; 0	11.3	33; 0	11.2
1992	5; 0	10.8	5; 0	10.8	50; 0	11.3	15; 0	11.0
1996	5; 0	7.5	5; 0	8.3	5; 0	9.1	15; 0	8.3
1999	6; 1	9.0	5; 0	8.7	4; 0	10.0	14; 1	9.2
2002	5; 1	8.0	5; 0	8.5	5; 0	9.7	15; 1	8.7

The annual averages for DO at all three sites as well as the lake average are not in violation of the DO standard at one foot depth during any sampling year. Figure 5-8 shows DO sampling results at one-foot depth over time. Only two violations have occurred on the lake. Both violations were sampled at RJM-1; one in 1999, and one in 2002. Lake averages were calculated using data from each sampling location.

5.2 Reservoir Characteristic

There are four impaired reservoirs in the Cahokia Canal watershed. Reservoir information that can be used for future modeling efforts was collected from GIS analysis, the U.S. Army Corps of Engineers, the Illinois EPA, and USEPA water quality data. The following sections will discuss the available data for each reservoir.

5.2.1 Frank Holten Lakes 1, 2, and 3

The Frank Holten Lakes are located in East St. Louis in St. Clair County. All three lakes are located within the Frank Holten State Park, which is maintained by the Illinois Department of Natural Resources. Table 5-9 contains lake information for each lake.

Table 5-9 Frank Holten Lakes

	Lake No. 1	Lake No. 2	Lake No. 3
Surface Area (acres)	97	40	80
Capacity (acre-feet)	500	NA	92.4
Shoreline (miles)	2.5	NA	2

Tables 5-10, -11, and -12 contain depth information for each sampling location on the lakes. The maximum water depths for Frank Holten Lakes No. 1, No. 2, and No. 3 are 13.0 feet, 21.1 feet, and 7.8 feet respectively.

Table 5-10 Average Depths (ft) for Frank Holten Lake No. 1 (Illinois EPA 2002 and USEPA 2002a)

Year	RJK-1
1990	13.7
1991	15.5
1992	13.2
1996	11.3
1997	6.7
1998	8.6
1999	17.1
2002	17.5
Average	**13.0**

Table 5-11 Average Depths (ft) for Frank Holten Lake No. 2 (Illinois EPA 2002 and USEPA 2002a)

Year	RJL-1
1990	23.5
1991	23.6
1992	23.1
1996	15.8
1999	19.7
2002	21.4
Average	**21.2**

Table 5-12 Average Depths (ft) for Frank Holten Lake No. 3 (Illinois EPA 2002 and USEPA 2002a)

Year	RJM-1	RJM-2	RJM-3
1990	9.3	9.3	8.0
1991	8.9	8.9	7.4
1992	9.0	8.9	8.0
1996	7.9	7.8	5.9
1997	5.9	7.0	5.7
1998	8.5	7.9	5.4
1999	6.6	6.3	4.1
2002	6.6	6.5	4.4
Average	**7.8**	**7.8**	**6.1**

5.3 Point Sources

Point sources for the Cahokia Canal watershed have been separated into municipal/industrial sources and mining discharges. Available data has been summarized and presented in the following sections.

5.3.1 Municipal and Industrial Point Sources

Permitted facilities must provide Discharge Monitoring Reports (DMRs) to Illinois EPA as part of their NPDES permit compliance. DMRs contain effluent discharge sampling results, which are then maintained in a database by the state. Figure 5-9 shows all permitted facilities whose discharge potentially reaches impaired segments. In order to assess point source contributions to the watershed, the data has been examined by receiving water and then by the downstream impaired segment that has the potential to receive the discharge. Receiving waters were determined through information contained in the USEPA Permit Compliance System (PCS) database. Maps were used to determine downstream impaired receiving water information when PCS data were not available. Many of the point sources in this watershed discharge directly to the Mississippi River. These point sources have not been used for watershed assessment. The impairments for each segment or downstream segment were considered when reviewing DMR data. Data has been summarized for any sampled parameter that is associated with a downstream impairment (i.e., all available nutrient and biological oxygen demand data was reviewed for segments that are impaired for dissolved oxygen). This will help in future model selection as well as source assessment and load allocation.

5.3.1.1 Cahokia Canal Segment JN 02

There are seven point sources with the potential to contribute discharge to Cahokia Canal Segment JN 02. Segment JN 02 is listed as impaired for dissolved oxygen. Table 5-13 contains a summary of available and pertinent DMR data for these point sources. Dissolved oxygen data is not required by all permits and was available for only three point sources.

Table 5-13 Effluent Data from Point Sources Discharging Upstream of or Directly to Cahokia Canal Segment JN 02 (Illinois EPA 2005)

Facility Name Period of Record Permit Number	Receiving Water/ Downstream Impaired Waterbody	Constituent	Average Value	Average Loading (lb/d)
Elementis Pigments, Inc. 1995-2005 IL0038709	Schoenberger Creek/Cahokia Canal Segment JN 02	Average Daily Flow	0.655 mgd	NA
		Nitrogen, Ammonia	1.12 mg/L	5.64
General Chemical LLC 2003-2004 IL0000647	Rose Creek/Cahokia Canal Segment JN 02	Average Daily Flow	0.0037 mgd	NA
Dot-Dist 8 Bowman Ave Pump Station 1997-2005 IL0070955	Cahokia Canal/Cahokia Canal Segment JN 02	Average Daily Flow	19 mgd	NA
		Nitrogen, Ammonia	0.722 mg/L	83.1
Maryville WTP 1996-2003 ILG640139	NA/Cahokia Canal Segment JN 02	Average Daily Flow	0.01 mgd	NA
Stone Meadows MHP 1994-2004 IL0046914	Cahokia Canal/Cahokia Canal Segment JN 02	Average Daily Flow	0.07 mgd	NA
		BOD, 5-Day	157.9 mg/L	
		CBOD, 5-Day	5.58 mg/L	2.05
		Oxygen, Dissolved	7.2 mg/L	
		Nitrogen, Ammonia	1.23 mg/L	0.36
Wheel Ranch MHP-Collinsville 1996-2003 IL0044598	NA/Cahokia Canal Segment JN 02	Average Daily Flow	0.015 mgd	NA
		BOD, 5-Day	431.8 mg/L	–
		CBOD, 5-Day	6.22 mg/L	0.258
		Nitrogen, Ammonia	2.94 mg/L	0.122
Holiday MHP 1995-2004 IL0038288	Unnamed Tributary to Cahokia Canal/Cahokia Canal Segment JN 02	Average Daily Flow	0.05 mgd	NA
		BOD, 5-Day	181.4 mg/L	71.9
		CBOD, 5-Day	7.01 mg/L	1.99
		Nitrogen, Ammonia	2.69 mg/L	0.39

5.3.1.2 Harding Ditch Segment JMAC02

There is one point source with the potential to contribute discharge to Harding Ditch Segment JMAC02. Segment JMAC02 is impaired for total fecal coliform. Table 5-14 contains a summary of available DMR data.

Table 5-14 Effluent Data from Point Sources Discharging to Harding Ditch Segment JMAC02 (Illinois EPA 2005)

Facility Name Period of Record Permit Number	Receiving Water/ Downstream Impaired Waterbody	Constituent	Average Value	Average Loading (lb/d)
Caseyville Township West STP 1993-2004 IL0023043	Clare Creek/Harding Ditch Segment JMAC02	Average Daily Flow	0.786 mgd	NA
		Total fecal coliform	138.0 mg/L	–

5.3.1.3 Canteen Creek Segment JNA 01

There is one point source with the potential to contribute discharge to Canteen Creek Segment JNA 01. Segment JNA 01 is impaired for manganese. Table 5-15 contains a summary of available DMR data.

Table 5-15 Effluent Data from Point Sources Discharging to Canteen Creek Segment JNA 01 (Illinois EPA 2005)

Facility Name Period of Record Permit Number	Receiving Water/ Downstream Impaired Waterbody	Constituent	Average Value	Average Loading (lb/d)
Collinsville STP 1989-2005 IL0028215	Canteen Creek/Canteen Creek Segment JNA01	Average Daily Flow	4.41 mgd	NA
		Manganese	0.017 mg/L	–

5.3.1.4 Other

There are no permitted facilities that discharge directly to any of the Frank Holten Lakes.

5.3.2 Stormwater Discharges

There are a number of municipal separate storm sewer systems (MS4) throughout the Cahokia Canal watershed. Permit data were pulled from the EPA PCS database and reviewed for receiving water information. There are four MS4 permits which list impaired waters within the Cahokia Canal watershed as receiving waters. Table 5-16 contains permit information for these MS4s.

Table 5-16: MS4 Permit Information

Facility Information	Permit ID	Receiving Water
EAST SAINT LOUIS, CITY OF	ILR400332	Cahokia Canal
CASEYVILLE TOWNSHIP	ILR400024	Canteen Creek
COLLINSVILLE TOWNSHIP	ILR400032	Canteen Creek
COLLINSVILLE, CITY OF	ILR400316	Canteen Creek

5.3.3 Mining Discharges

There are no permitted mine sites or recently abandoned mines within the Cahokia Canal watershed. If additional information becomes available, it will be reviewed and considered during Stage 3 of TMDL development.

5.4 Nonpoint Sources

There are many potential nonpoint sources of pollutant loading to the impaired segments in the Cahokia Canal watershed. This section will discuss site-specific cropping practices, animal operations, and area septic systems. Data was collected through communication with local NRCS, Soil and Water Conservation District (SWCD), Public Health Department, and County Tax Department officials.

5.4.1 Crop Information

A portion of the land found within the Cahokia Canal watershed is devoted to crops. Corn and soybean farming account for approximately 13 percent and 15 percent of the watershed respectively. Tillage practices can be categorized as conventional till, reduced till, mulch-till, and no-till. The percentage of each tillage practice for corn, soybeans, and small grains by county are generated by the Illinois Department of Agriculture from County Transect Surveys. The most recent survey was conducted in 2004. Data specific to the Cahokia Canal watershed were not available; however, the Madison, St. Clair, and Monroe County practices were available and are shown in the following tables.

Table 5-17 Tillage Practices in Madison County

Tillage System	Corn	Soybean	Small Grain
Conventional	68%	8%	6%
Reduced - Till	21%	35%	21%
Mulch - Till	7%	22%	23%
No - Till	4%	35%	49%

Table 5-18 Tillage Practices in St. Clair County

Tillage System	Corn	Soybean	Small Grain
Conventional	96%	27%	0%
Reduced - Till	1%	22%	0%
Mulch - Till	1%	10%	0%
No - Till	1%	41%	0%

Table 5-19 Tillage Practices in Monroe County

Tillage System	Corn	Soybean	Small Grain
Conventional	60%	10%	6%
Reduced - Till	32%	37%	21%
Mulch - Till	2%	19%	23%
No - Till	6%	33%	49%

The Cahokia Canal watershed is situated in a predominately urban area. Much of the watershed in Madison County is situated in the Mississippi River flood plain and is protected by a U.S. Army Corps of Engineers levee system. Communications with local NRCS offices indicate that soils are favorable for subsurface tile drainage systems although no specific watershed data is available. It is estimated that approximately 5,000 acres are tiled in the Madison County portion of this watershed. Tile drainage estimates from other watershed counties were not available. Site-specific data will be incorporated if it becomes available. Without local information, soils data will be reviewed for information on hydrologic soil group in order to provide a basis for tile drain estimates.

5.4.2 Animal Operations

Watershed specific animal numbers were not available for the Cahokia Canal watershed. Data from the National Agricultural Statistics Service was reviewed and is presented below to show countywide livestock numbers.

Table 5-20 Madison County Animal Population (2002 Census of Agriculture)

	1997	2002	Percent Change
Cattle and Calves	17,690	15,809	-11%
Beef	5,890	5,931	1%
Dairy	1,774	1,683	-5%
Hogs and Pigs	46,331	29,844	-36%
Poultry	1,517	NA	NA
Sheep and Lambs	1,047	1,013	-3%
Horses and Ponies	NA	1,226	NA

Table 5-21 St. Clair County Animal Population (2002 Census of Agriculture)

	1997	2002	Percent Change
Cattle and Calves	8,362	6,985	-16%
Beef	1,888	1,656	-12%
Dairy	1,096	1,039	-5%
Hogs and Pigs	39,433	30,188	-23%
Poultry	1,426	790	-45%
Sheep and Lambs	449	374	-17%
Horses and Ponies	NA	879	NA

Table 5-22 Monroe County Animal Population (2002 Census of Agriculture)

	1997	2002	Percent Change
Cattle and Calves	10,200	9,846	-3%
Beef	3,525	3,451	-2%
Dairy	950	1,351	42%
Hogs and Pigs	52,235	42,551	-19%
Poultry	444	560	26%
Sheep and Lambs	973	667	-31%
Horses and Ponies	NA	446	NA

Again, the Cahokia Canal watershed is situated in a predominately urban area. It is estimated that there are very few livestock operations, although it is thought that there are a small number of horse stables located in the watershed. Any additional site-specific information that becomes available will be incorporated.

5.4.3 Septic Systems

Many households in rural areas of Illinois, which are not connected to municipal sewers, make use of onsite sewage disposal systems, or septic systems. There are a variety of types of septic systems, but the most common septic system is composed of a septic tank draining to a septic field, where nutrient removal occurs. However, the degree of nutrient removal is limited by soils and system upkeep and maintenance.

Information on septic systems has been obtained for St. Clair and Monroe Counties. Septic system information for Madison County is not available. Table 5-23 is a summary of the available septic system data in the Cahokia Canal watershed.

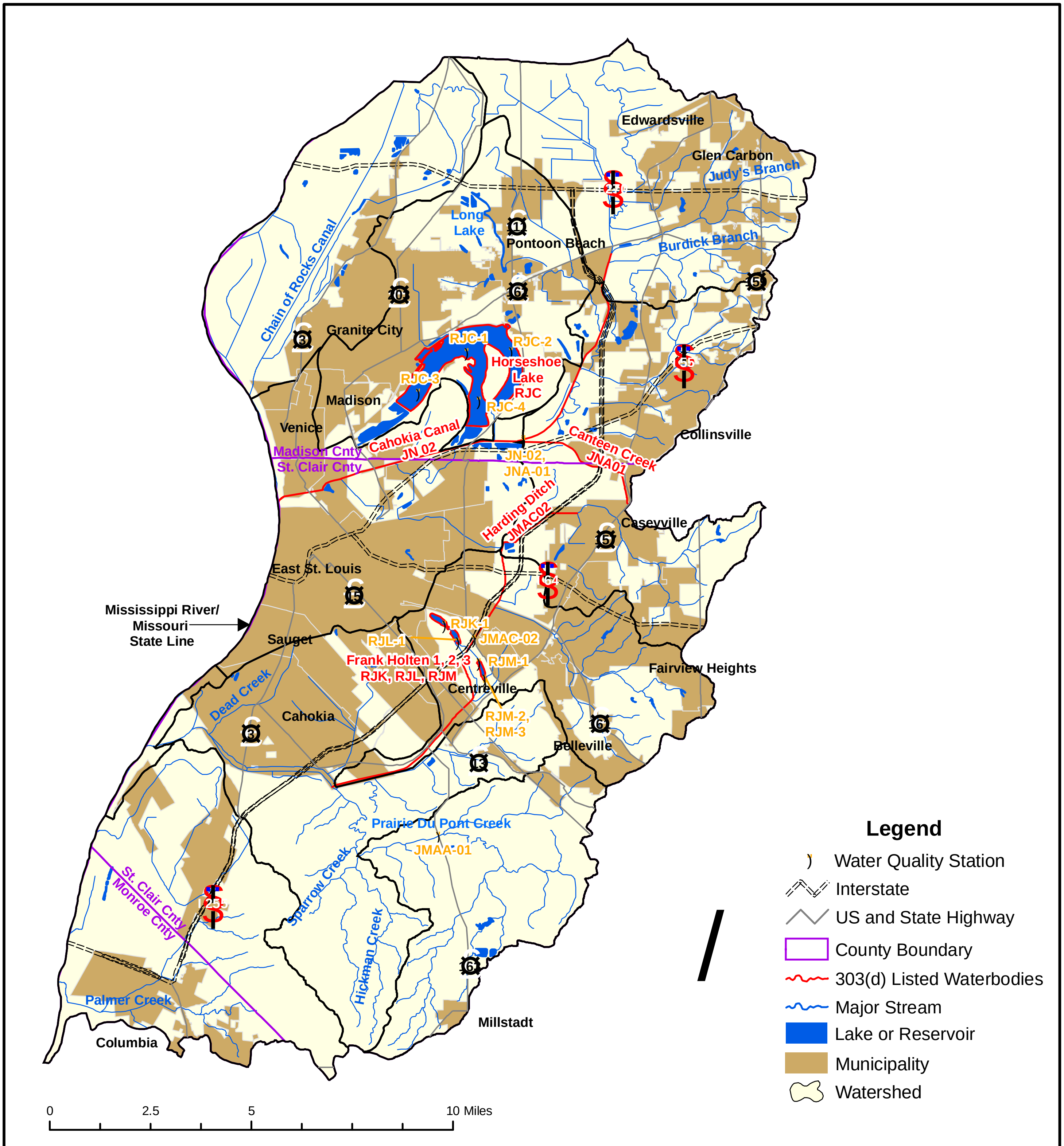
Table 5-23 Estimated Septic Systems in the Cahokia Canal Watershed

County	Estimated No. of Septic Systems	Source of Septic Areas/ No. of Septic Systems
Madison	N/A	
St. Clair	5,000	County Health Department, East Side Health District, City of Fairview Heights
Monroe	45	Health Department
Total	**5,045**	

There are approximately 5,000 septic systems in the Cahokia Canal watershed. The area within St. Clair County falls under three separate jurisdictions: St. Clair County, Fairview Heights, and East Side Health District. Estimates of the number of septic systems in the watersheds were obtained for each of the three entities and summed for the county total. There are 700 septic systems within St. Clair County's jurisdiction, 4,000 in Fairview Heights, and 300 within the East Side Health District's jurisdiction. All of the area in Monroe County within the watershed is served by septic systems. Most of the municipalities surrounding Long Lake and Frank Holten 1, 2, and 3 are sewered.

5.5 Watershed Studies and Other Watershed Information

Previous planning efforts have been conducted in the Cahokia Canal watershed. In the summer of 1998, and intensive survey of the Mississippi South Central Basin was conducted. A Phase III, Post-Restoration Monitoring Report was also completed for the Frank Holten Lakes in 1994. Data from these studies will be used as a reference during Stage 3 of TMDL development. Further investigation will be conducted on other watershed planning efforts and local watershed groups. Any available and relevant information will be collected and incorporated during Stage 3 of TMDL development.



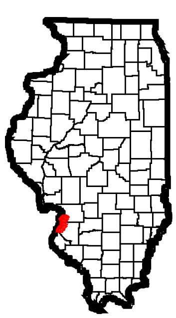


Figure 5-1
Cahokia Canal/Horseshoe Lake Watershed
Water Quality Stations

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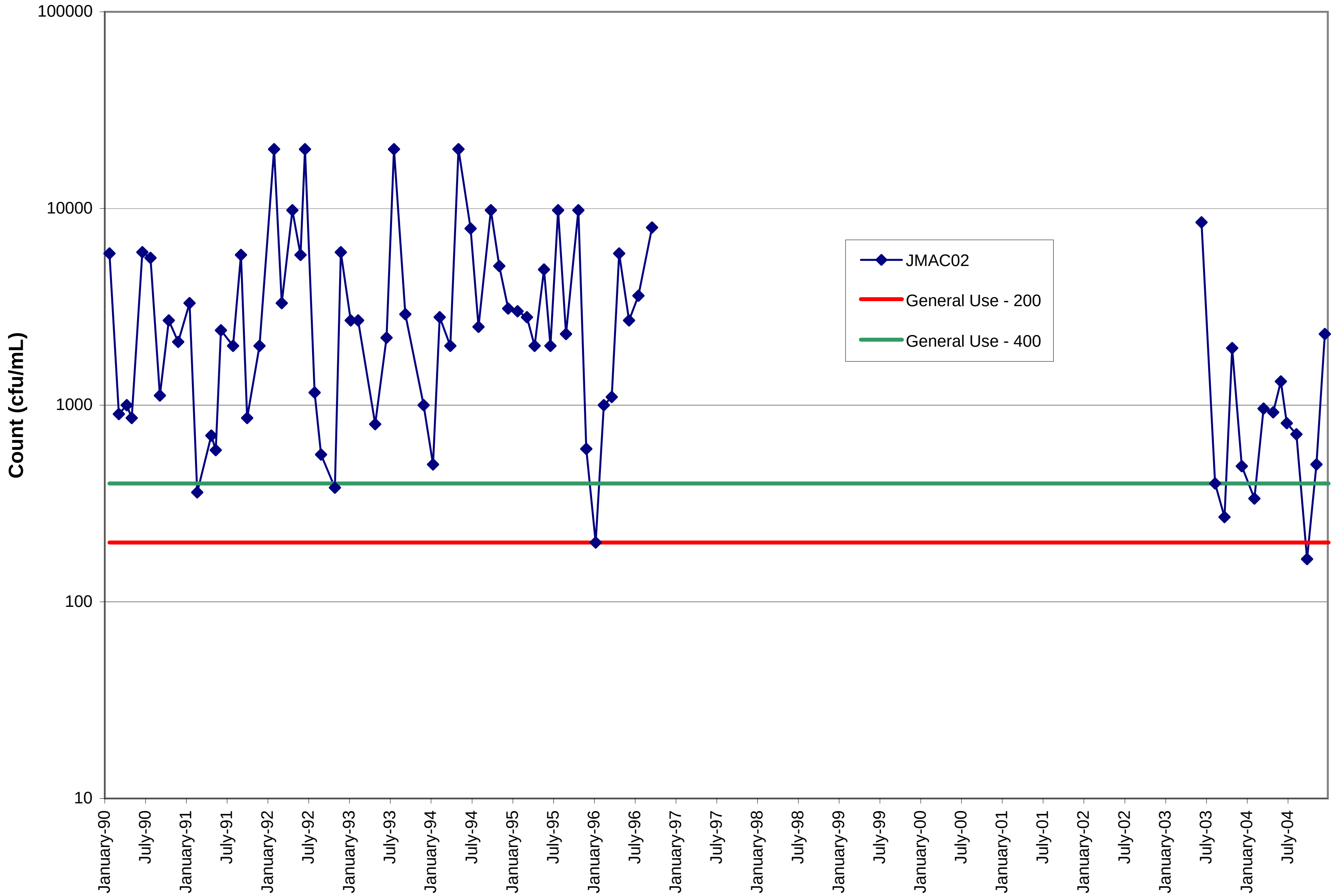

CDM

V:\6 Cahokia Canal_Horseshoe Lake\Data\Stream-Fecal.xlsCahokia Canal Fecal

Figure 5-2:
Harding Ditch JMAC02
Total Fecal Coliform

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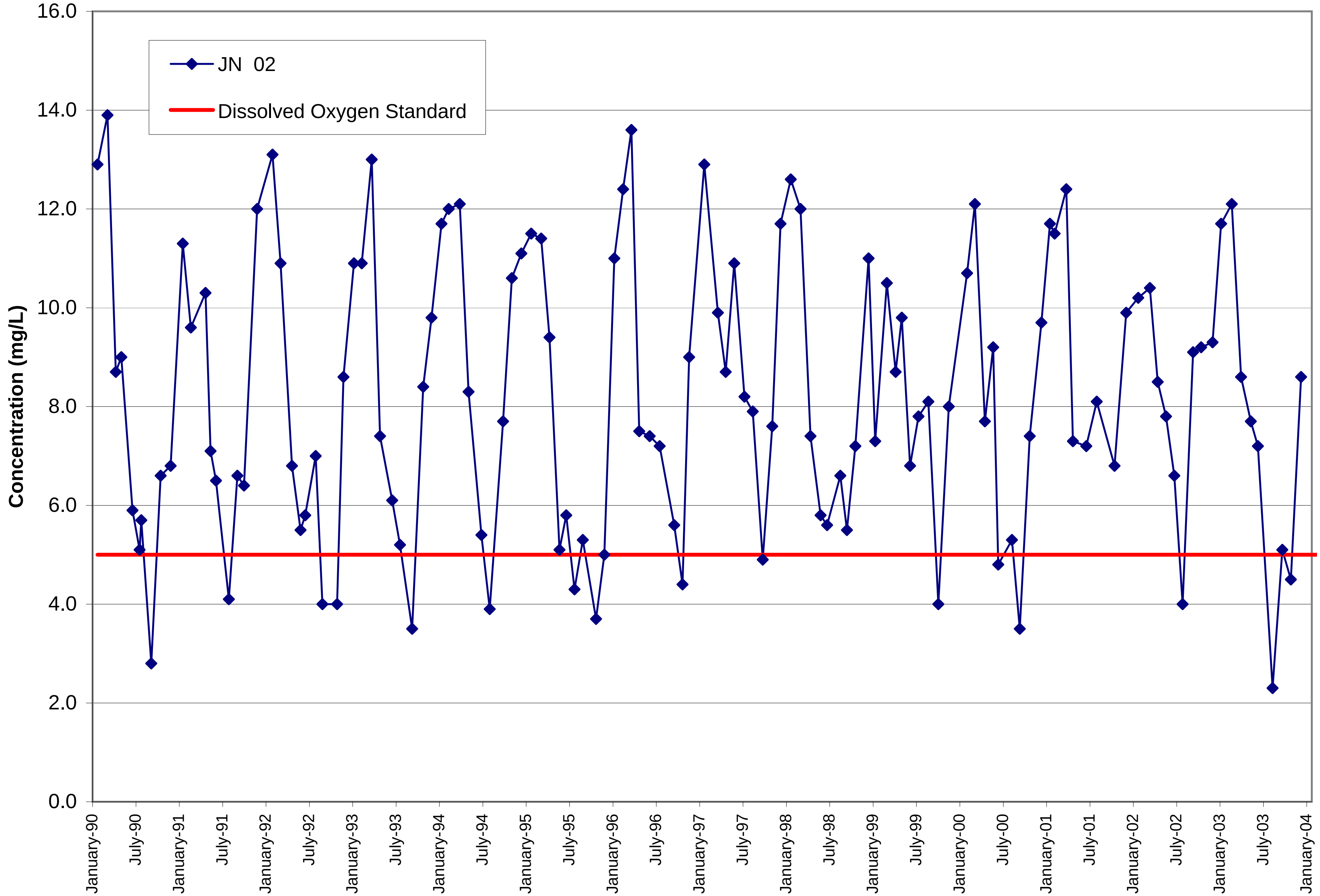

CDM

T:\GIS\6 Cahokia Canal_Horseshoe Lake\Data\Stream-DO.xlsDO-timeseries

Figure 5-3:
Cahokia Canal Segment JN02
Dissolved Oxygen Concentrations

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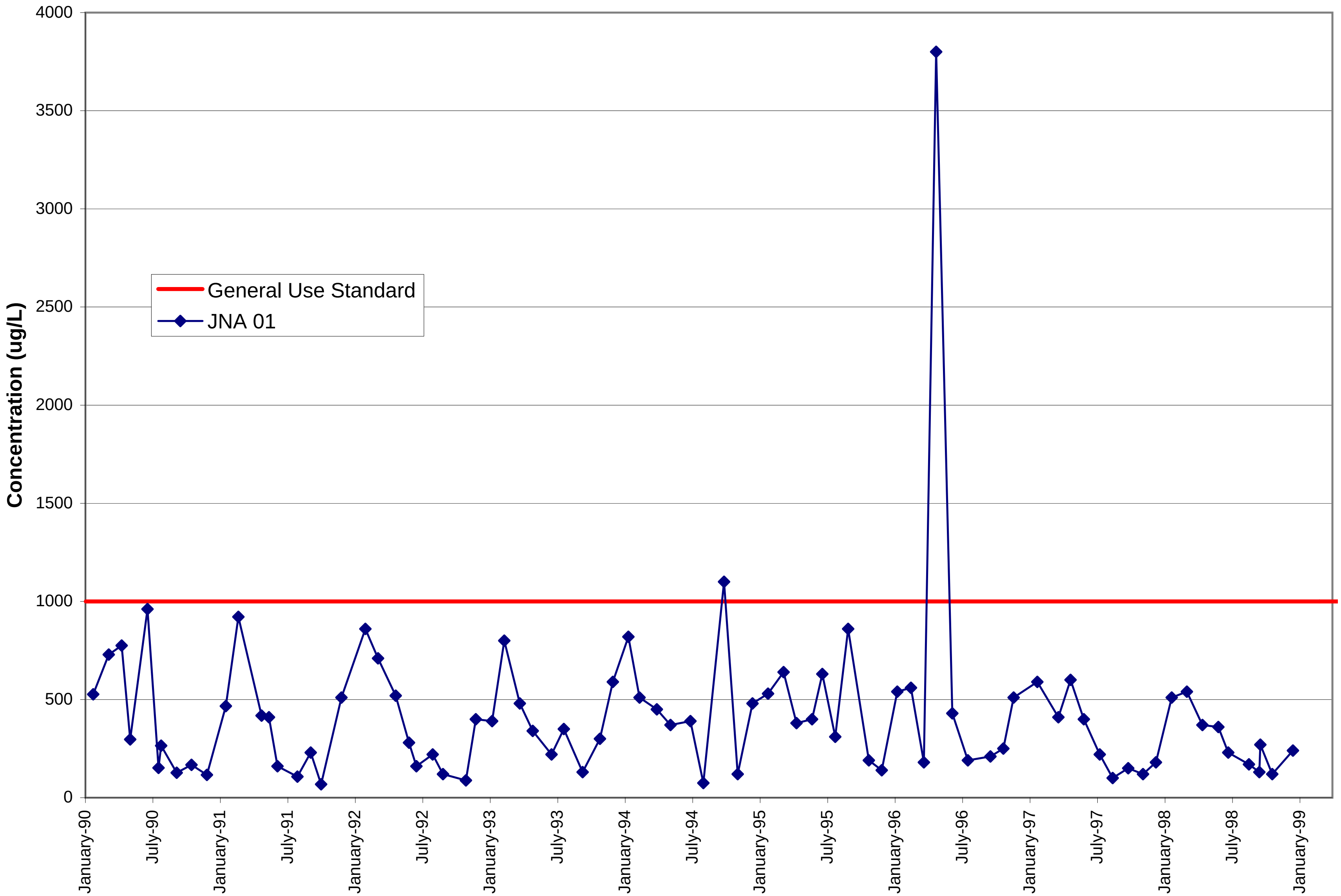

CDM

Figure 5-4:
Canteen Creekk JNA01
Total Manganese Concentrations

V:\6 Cahokia Canal_Horseshoe Lake\Data\Stream-Other.xlsManganese

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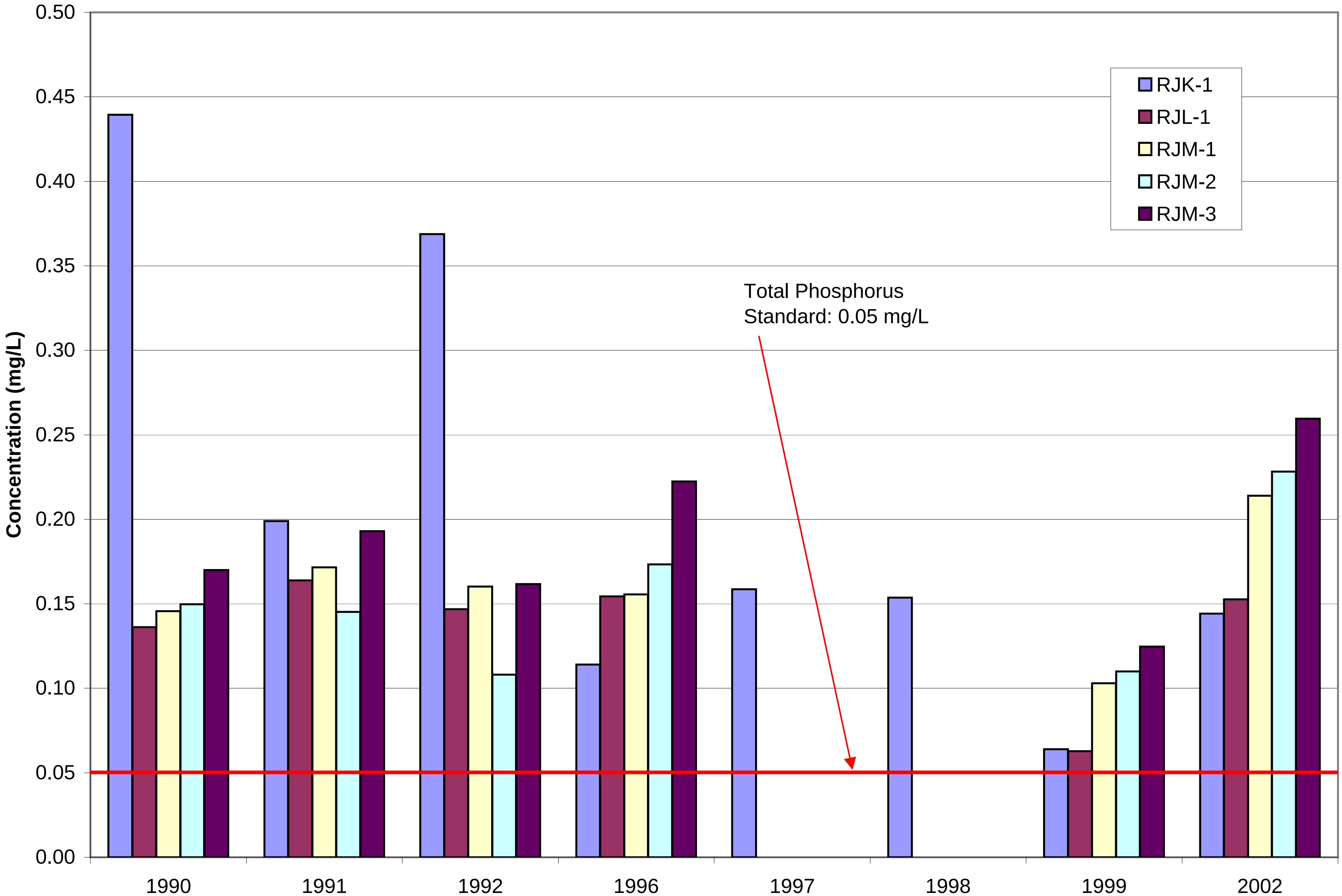

CDM

Figure 5-7:
Frank Holten Lakes
Annual Average Total Phosphorus Concentrations

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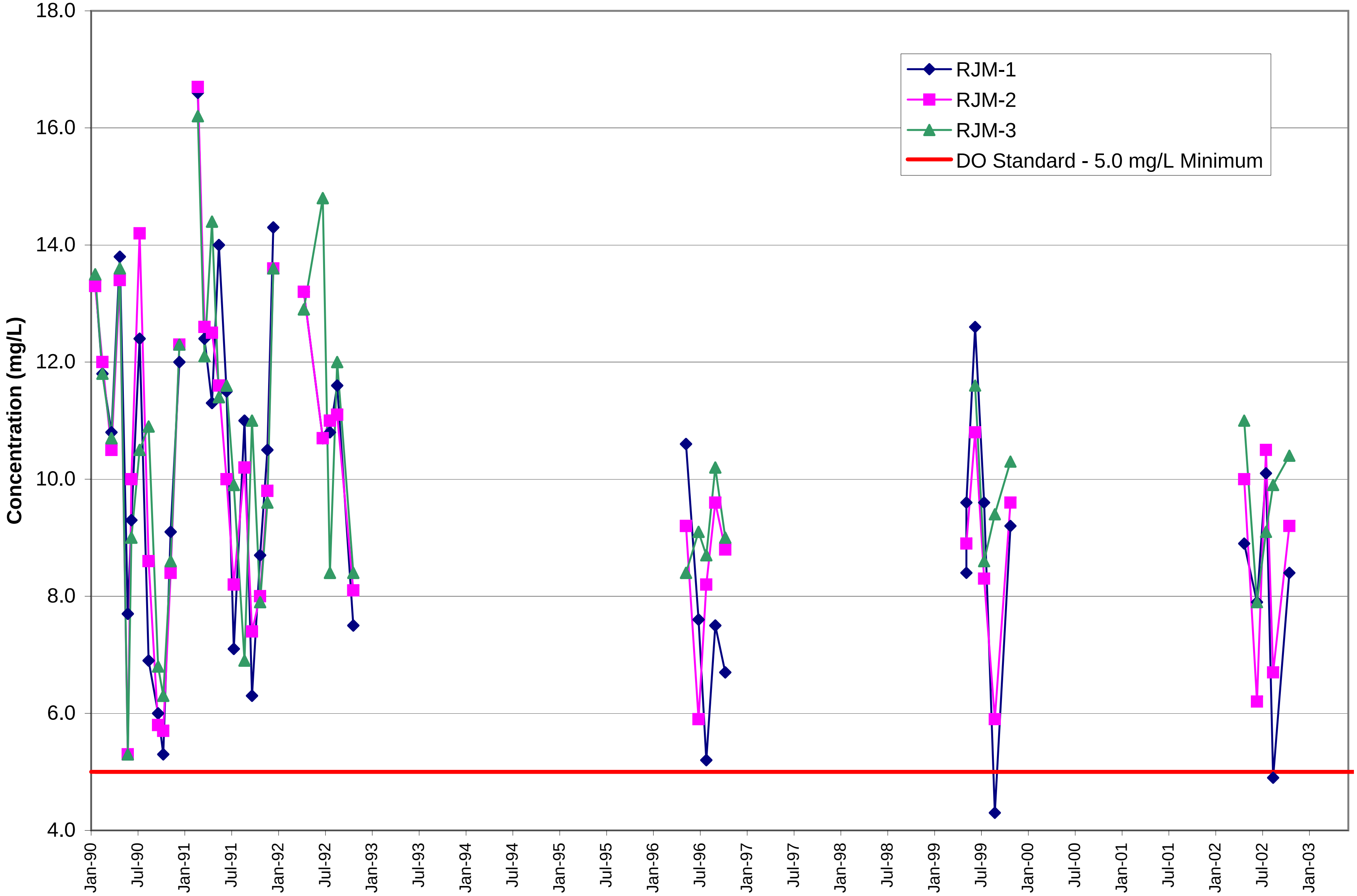

CDM

N:\6 Cahokia Canal_Horseshoe Lake\Data\frank-holten-data.xlsDO

Figure 5-8:
Frank Holten Lake #3
Dissolved Oxygen Concentrations

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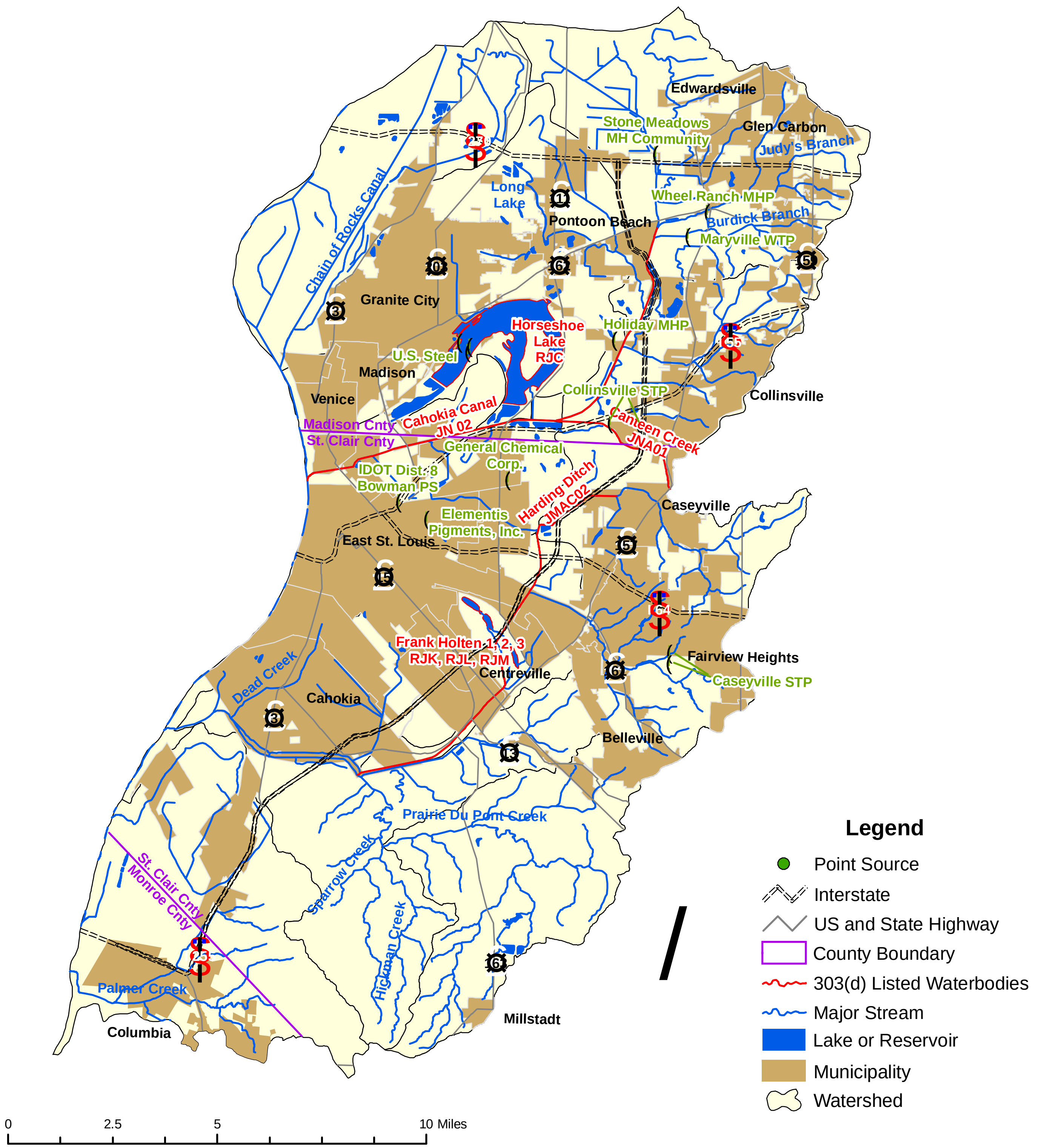

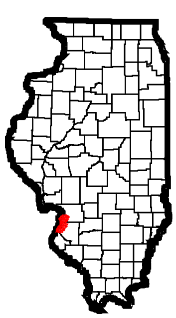

Figure 5-9
Cahokia Canal/Horseshoe Lake Watershed
NPDES Permits

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Section 6
Approach to Developing TMDL and Identification of Data Needs

Illinois EPA is currently developing TMDLs for pollutants that have numeric water quality standards. Of the pollutants impairing stream segments in the Cahokia Canal watershed, manganese, DO, and fecal coliform are the parameters with numeric water quality standards. For the impaired lakes in the watershed, phosphorus, DO, and pH are the parameters with numeric water quality standards. Illinois EPA believes that addressing these impairments should lead to an overall improvement in water quality due to the interrelated nature of the other listed pollutants. Recommended technical approaches for developing TMDLs for streams and lakes are presented in this section. Additional data needs are also discussed.

6.1 Simple and Detailed Approaches for Developing TMDLs

The range of analyses used for developing TMDLs varies from simple to complex. Examples of a simple approach include mass-balance, load-duration, and simple watershed and receiving water models. Detailed approaches incorporate the use of complex watershed and receiving water models. Simple approaches typically require less data than detailed approaches and therefore these are the analyses recommended for the Cahokia Canal watershed except for stream segments where major point sources whose NDPES permit may be affected by the TMDL's WLA. Establishing a link between pollutant loads and resulting water quality is one of the most important steps in developing a TMDL. As discussed above, this link can be established through a variety of techniques. The objective of the remainder of this section is to recommend approaches for establishing these links for the constituents of concern in the Cahokia Canal Watershed.

6.2 Approaches for Developing TMDLs for Stream Segments in the Cahokia Canal Watershed

All of the impaired stream segments with the watershed have major point sources discharging to them. Approaches for developing TMDLs for parameters that are possibly affected by point sources as well as TMDLs for parameters not likely influenced by point sources are described below.

6.2.1 Recommended Approach for DO TMDLs for Segments with Major Point Sources

Cahokia Canal Segment JN02 has point sources discharging directly to or upstream of it. For this segment a more complicated approach that would also incorporate the impacts of stream plant activity, and possibly sediment oxygen demand (SOD), and would require a more sophisticated numerical model and an adequate level of measured data to aide in model parameterization is recommended.

Available instream water quality data for the impaired stream segment is limited, particularly spatial data. Therefore additional data collection is recommended for this segment. Specific data requirements include a synoptic (snapshot in time) water quality survey of this reach with careful attention to the location of the point source dischargers. This survey should include measurements of flow, hydraulics, DO, temperature, nutrients, and CBOD. The collected data will be used to support the model development and parameterization and will lend significant confidence to the TMDL conclusions.

This newly collected data could then be used to support the development and parameterization of a more sophisticated DO model for this stream and therefore, the use of the QUAL2E model (Brown and Barnwell 1985) could be utilized to accomplish the TMDL analysis for Cahokia Canal. QUAL2E is well-known and USEPA-supported. It simulates DO dynamics as a function of nitrogenous and carbonaceous oxygen demand, atmospheric reaeration, SOD, and phytoplankton photosynthesis and respiration. The model also simulates the fate and transport of nutrients and BOD and the presence and abundance of phytoplankton (as chlorophyll-a). Stream hydrodynamics and temperature are important controlling parameters in the model. The model is essentially only suited to steady-state simulations.

In addition to the QUAL2E model, a simple watershed model such as PLOAD, Unit Area Loads or the Watershed Management Model is recommended to estimated BOD and nutrient loads from non-point sources in the watershed. This model will allow for allocation between point and nonpoint source loads and provide an understanding of percentage of loadings from point sources and nonpoint sources in the watershed.

6.2.2 Recommended Approach for Fecal Coliform TMDLs

Segment JMAC02 of Harding Ditch is impaired for fecal coliform. The general use water quality standard for total fecal coliform is:

- 200 cfu/100 mL geometric mean based on a minimum of five samples taken over not more than a 30 day period during the months of May through October
- 400 cfu/100 mL shall not be exceeded by more than 10 percent of the samples collected during any 30 day period during the months of May through October

As discussed in Section 5.1.1.1, there have been no instances when five or more samples have been taken within a 30 day period. More data is required in order to properly assess compliance with the standard.

If it is confirmed that the segment is impaired for total fecal coliform, the recommended approach for developing a TMDL for the segment would be to use the load-duration curve method. The load-duration methodology uses the cumulative frequency distribution of streamflow and pollutant concentration data to estimate the allowable loads for a waterbody.

6.2.3 Recommended Approach for Manganese TMDL

Segment JNA01 of Canteen Creek is impaired for manganese. No apparent source of manganese has been identified to date and therefore, an empirical loading and spreadsheet analysis will be utilized to calculate this TMDL.

6.3 Approaches for Developing TMDLs for Lakes and Reservoirs in the Cahokia Canal Watershed

Recommended TMDL approaches for the Frank Holten Lakes will be discussed in this section. It is assumed that enough data exists to develop a simple model for use in TMDL development.

6.3.1 Recommended Approach for Total Phosphorus, DO, and pH TMDLs

Each of the Frank Holten Lakes are impaired for total phosphorus. Frank Holten Lake #3 is also impaired for DO. The BATHTUB model is recommended for all lake phosphorus and DO assessments in this watershed. The BATHTUB model performs steady-state water and nutrient balance calculations in a spatially segmented hydraulic network that accounts for advective and diffusive transport, and nutrient sedimentation. The model relies on empirical relationships to predict lake trophic conditions and subsequent DO conditions as functions of total phosphorus and nitrogen loads, residence time, and mean depth (USEPA 1997). Oxygen conditions in the model are simulated as meta and hypolimnetic depletion rates, rather than explicit concentrations.

Watershed loadings to the lakes will be based on empirical data or tributary data available in the lake watersheds.

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Section 7
Methodology Development for the Cahokia Canal Watershed

7.1 Methodology Overview

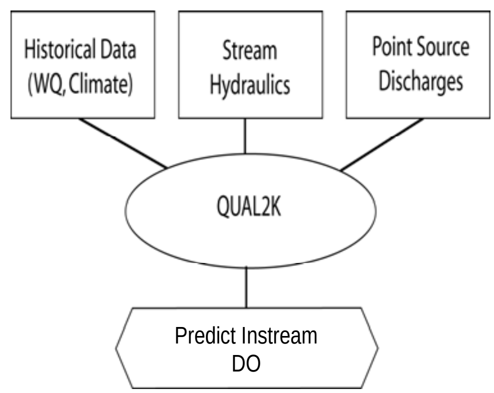
Table 7-1 contains information on the methodologies selected and used to develop TMDLs for impaired segments within the Cahokia Canal watershed.

Table 7-1 Methodologies Used to Develop TMDLs in the Cahokia Canal Watershed

Segment Name/ID	Cause of Impairment	Methodology
Cahokia Canal/JN02	Dissolved Oxygen	QUAL2K
Canteen Creek/JNA01	Manganese	Load-Duration Curve
Harding Ditch/JMAC02	Fecal Coliform	Load-Duration Curve
Frank Holten Lake #1/RJK	Total Phosphorus	BATHTUB
Frank Holten Lake #2/RJL	Total Phosphorus	BATHTUB
Frank Holten Lake #3/RJM	Total Phosphorus/Dissolved Oxygen	BATHTUB

7.1.1 QUAL2K Overview

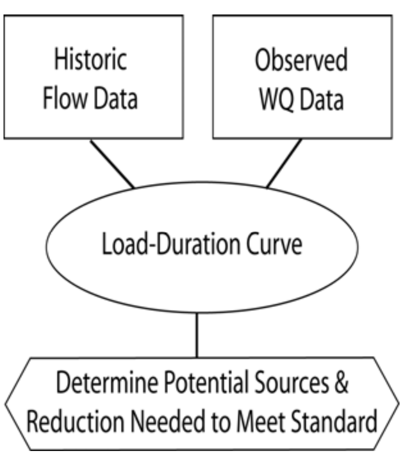
The QUAL2K model was used to develop the dissolved oxygen TMDL for segment JN02 of the Cahokia Canal. QUAL2K is a stream water quality model that is one-dimensional and applicable to well-mixed streams. The model assumes steady state hydraulics and allows for point source inputs, diffuse loading and tributary flows. Historic water quality data, observed hydraulic information, and point source discharge data were coupled with model defaults to predict the resulting instream DO concentrations.



Schematic 1

7.1.2 Load-Duration Curve Overview

A loading capacity analysis was performed for Canteen Creek (segment JNA01) and Harding Ditch (segment JMAC02). A load-duration curve is a graphical representation of the maximum load of a pollutant, in this case total manganese for Canteen Creek and fecal coliform for Harding Ditch, that a segment can assimilate over a range of flow scenarios while still meeting the instream water quality standard. The load-duration curve approach provides useful information regarding the magnitude and frequency of exceedences as well as the flow scenarios when exceedences occur most often.

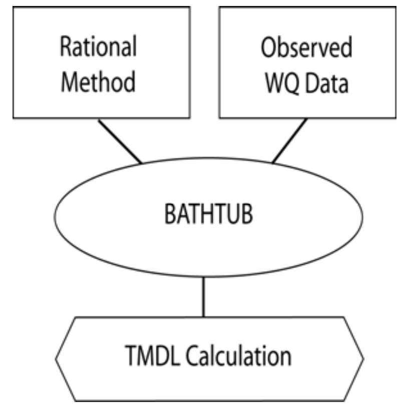


Schematic 2

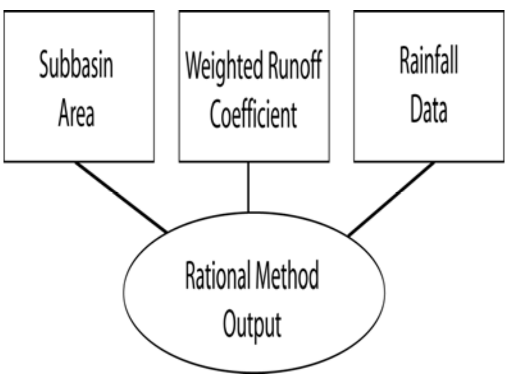
7.1.3 BATHTUB Overview

The approach taken for TMDL analysis for the Frank Holten Lakes included using observed data coupled with the rational method as inputs to the BATHTUB model. This method required inputs from several sources including online databases and GIS-compatible data.

Schematic 3 shows the data inputs for the BATHTUB model that were used to calculate the TMDLs. Flow and concentration data were limited to a single subbasin for both lakes' watersheds. Historic data were used when available and the rational method was used to estimate runoff and concentrations from small subbasins adjacent to the impaired lakes when no data were available. The rational method (see Schematic 4) calculates a subbasin discharge based on the subbasin area, precipitation data, and a weighted runoff coefficient derived from the imperviousness of the subbasin land uses. In addition, event mean concentration (EMC) data were used in conjunction with land use data to estimate total phosphorus concentrations from the subbasin areas with no historic data.

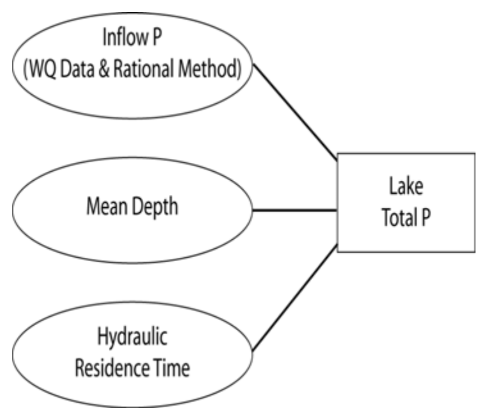


Schematic 3



Schematic 4

Once the subbasin flows and concentrations were estimated, they were used as input for the BATHTUB model. The BATHTUB model uses empirical relationships between mean reservoir depth, total phosphorus inputted to the lake, and the hydraulic residence time to determine in-reservoir concentrations (see Schematic 5).



Schematic 5

7.2 Methodology Development

The following sections further discuss and describe the methodologies utilized to examine DO, manganese, fecal coliform and total phosphorus levels in the impaired waterbodies in the Cahokia Canal watershed.

7.2.1 QUAL2K Model

QUAL2K (Q2K) is a river and stream water quality model that is intended to represent a modernized version of the QUAL2E (Q2E) model (Brown and Barnwell 1987). The original Q2E model is well-known and USEPA-supported. The modernized version has been updated to use Microsoft Excel as the user interface and has expanded the options for stream segmentation as well as a number of other model inputs. Q2K simulates DO dynamics as a function of nitrogenous and carbonaceous oxygen demand, atmospheric reaeration, SOD, and plant photosynthesis and respiration. The model also simulates the fate and transport of nutrients and BOD and the growth and abundance of floating (phytoplankton) and attached (periphyton) algae (as chlorophyll-a). Stream hydrodynamics and temperature are important controlling parameters in the model. Headwater, point source, and non-point source loadings and flows are explicitly input by the user. The model simulates steady-state diurnal cycles. Model parameter default values are provided in the model based on past studies and are recommended in the absence of site-specific information.

7.2.1.1 QUAL2K Inputs

Table 7-2 contains the categories of data required for the Q2K model along with the sources of data used to analyze segment JN02 of the Cahokia Canal.

Table 7-2 Q2K Data Inputs

Input Category	Data Source
Stream Segmentation	GIS data
Hydraulic characteristics	CDM field survey; aerial photographs; GIS
Headwater conditions	CDM field survey; Historic water quality data collected at JN02
Meteorologic conditions	National Climatic Data Center
Point Source contributions	Illinois EPA

Empirical data amassed during Stage 1 of TMDL development were used to build the Q2K model for the Cahokia Canal. In addition to the Stage 1 data, aerial photographs, GIS data and stream cross-section and flow measurements from a CDM field survey were used for the Q2K model.

7.2.1.1.1 Stream Segmentation

The Q2K model represents a river as a series of reaches. Each reach shares constant channel geometry and hydraulic characteristics. Cahokia Canal was divided into 5 reaches and Canteen Creek was added as a tributary. The modeled Canteen Creek segment extended from the Collinsville Sanitary Treatment Plant (STP) to the confluence with the canal. Figure 7-1 shows the stream segmentation used for the Q2K model.

7.2.1.1.2 Hydraulic Characteristics

The majority of stream hydraulics were specified in the model based on a CDM field survey conducted in May 2007 under low-flow conditions. Four wetted cross-sections were surveyed by measuring depths, velocities, and widths at multiple points across a transect. The four cross-section locations, shown in Figure 7-1, were chosen to achieve an adequate spatial representation of the modeled reach. A fifth target location (near the Route 203 crossing) was not wadeable and therefore was not gaged. Visual and photograph characterization, however, were used to guide model hydraulic inputs for this downstream area. Appendix E contains field sheets and photographs from this survey. In addition, no hydraulic data were available for the modeled portion of Canteen Creek. The Manning's Equation was used to drive hydraulics for this segment based on estimated channel width from aerial photographs, channel slope from the National Elevation Dataset, and an estimated Manning's roughness coefficient.

7.2.1.1.3 Headwater Conditions

The model was set up with two headwaters; Cahokia Canal and Canteen Creek. The following describes conditions for each segment.

7.2.1.1.3.1 Cahokia Canal

A review of historic water quality data for the modeled reach of Cahokia Canal showed that there have been 16 violations of the dissolved oxygen standard recorded since 1990 (out of 126 total samples). Of the 16 violating samples, 15 were collected between July and October, which are also the months that experience the lowest flows in the area. This indicated that dissolved oxygen problems are associated with low-flow periods. Therefore, low-flow, summer conditions were used for model development.

The headwater flow and concentrations are user-specified in the model and represent the system's upstream boundary condition. Measured concentration data were not specifically available for the modeled headwater segment. However, historic water quality data collected at sampling site JN02 (Cahokia Canal at Sand Prairie Rd, approximately 4.5 miles downstream) were available and were used as a surrogate headwater concentration data set. Only water quality data collected in the months of July, August, September, and October were used for this model. Because there are no major inputs to the system between the headwaters and the sampling location JN02, it was assumed that data collected at the sampling location were representative of conditions at the headwaters.

The upstream flows measured during the CDM field survey (May, 2007) were in the range of 4.2 – 4.9 cfs. Due to the fact that the modeled hydraulics (based on the only available data) are associated with this measured flow range, a headwater flow rate of 4.2 cfs is assumed in the model. This value is considered adequately representative of low-flow, critical conditions. For reference, the 7Q10 low flow for Cahokia Canal upstream of the confluence with Canteen Creek is 2.4 cfs.

7.2.1.1.3.2 Canteen Creek

Data for Canteen Creek are limited. The modeled segment extended from the Collinsville STP discharge point to the confluence with Cahokia Canal. According to the Collinsville STP permit, 7Q10 low flows on this segment are 0 cfs. Therefore, water quality conditions and flow for this segment were inputted using historic DMR records from the STP assuming that the facility's effluent discharge rate and quality are representative of instream flows and water quality during critical low flow times.

Where historic DMR data were missing, concentration data were estimated using mean summer values from Canteen Creek water quality monitoring station JNA01.

7.2.1.1.4 Climate

Q2K requires inputs for climate. Temperature and wind speed data from Lambert International Airport in St. Louis, Missouri were used for the model.

7.2.1.1.5 Point Sources

A number of point sources discharge within the Cahokia Canal watershed. Q2K allows user input of point source locations, flow and water quality data. Permit records were reviewed and permitted discharge data were used for model input. Table 7-3 contains information for each facility while Figure 7-1 shows the locations of each facility. Flow information was available for each discharger; however, permit limit concentration data are available only for parameters that are sampled per permit requirements.

Table 7-3 Point Source Discharges within the Cahokia Canal Watershed

Facility Name	Permit Number	Permitted Facility Flows	Segment Number
Stone Meadows MHP	IL0046914	0.07	1
Wheel Ranch MHP	IL0044598	0.02	1
Maryville WTP	ILG640139	0.01	1
Holiday MHP	IL0038288	0.05	2
Collinsville STP(1)	IL0028215	5.85	4
General Chemical	IL0000647	No Discharge	-
Elementis Pigments	IL0038709	2.0	6
Bowman Avenue Pump Station	IL0070955	No Discharge during low flow periods	-

(1) Collinsville STP is not explicitly modeled as a point source in the Cahokia Canal QUAL2K because it accounted for in the headwater conditions for Canteen Creek (see discussion in 7.1.1.3.2)

7.2.1.2 QUAL2K Calibration

Sufficient water quality data were not available to perform a calibration of model kinetic and transport rates. Specifically, a spatial distribution of measured data is lacking to guide parameterization of this steady-state model. All available data are from a single location on Cahokia Canal (JN02) and a single location on Canteen Creek (JNA01). Therefore, all model rates, including key rates of BOD decay, nitrification, and algae growth, were maintained at default values. Model hydrodynamic dispersion, reaeration, and sediment oxygen demand (SOD) are calculated internally in the model based on physical, chemical, and biological conditions. "Truth checking" was performed on key model calculated parameters, such as reaeration rates, SOD fluxes, temperature, and phytoplankton concentrations using literature values and best professional judgment.

Appendix F contains the model input/output worksheets.

7.2.2 Load Duration Curve Development

Load duration curves are used to gain understanding of the range of loads allowable throughout the flow regime of a stream. This approach was used to characterize the current loading of fecal coliform in segment JMAC02 of Harding Ditch and total manganese in segment JNA01 of Canteen Creek.

7.2.2.1 Watershed Delineation and Flow Estimation

Watersheds for the areas contributing directly to Canteen Creek segment JNA01 and Harding Ditch segment JMAC02 were delineated with GIS analyses through use of the NED as discussed in Section 2.2. The delineation suggests that Canteen Creek segment JNA01 captures flows from a directly contributing watershed of approximately 27.2 square miles and Harding Ditch segment JMAC02 captures flows from a directly contributing watershed of approximately 56 square miles total. Figures 7-2 and 7-3 at the end of this section show the location of the water quality stations on each segment as well as the boundary of the GIS-delineated watershed.

In order to create a load duration curve, it is necessary to obtain flow data corresponding to each water quality sample. As discussed in Section 2.6.2, there are no USGS stream gages within the watersheds that have current, or even recent, streamflow data. Therefore, the drainage area ratio method, represented by the following equation, was used to estimate flows.

$$Q_{gaged}\left(\frac{Area_{ungaged}}{Area_{gaged}}\right) = Q_{ungaged}$$

where Q_{gaged} = Streamflow of the gaged basin
$Q_{ungaged}$ = Streamflow of the ungaged basin
$Area_{gaged}$ = Area of the gaged basin
$Area_{ungaged}$ = Area of the ungaged basin

The assumption behind the equation is that the flow per unit area is equivalent in watersheds with similar characteristics. Therefore, the flow per unit area in the gaged watershed multiplied by the area of the ungaged watershed estimates the flow for the ungaged watershed.

USGS gage 05588000 (Indian Creek near Wanda, Illinois) was chosen as a surrogate gage from which to estimate flows in both Harding Ditch and Canteen Creek. The Indian Creek watershed is approximately 17 miles west northwest of Harding Ditch sampling site JMAC02 and 12 miles north of sampling site JNA01 on Canteen Creek. The gage drains an area that is a similar order of magnitude with similar land uses and receives comparable precipitation throughout the year. Gage 05588000 captures flow from a slightly less urbanized drainage area of 37 square miles. The Harding Ditch watershed encompasses 33 square miles up to sampling site JMAC02 and the Canteen Creek watershed drains 27 square miles at sampling site JNA01.

Data were downloaded through the USGS for the Indian Creek gage and minor corrections were made to account for point source flow influence. First, daily average flows (DAF) from the Bunker Hill STP (located upstream of the Indian Creek streamgage) were subtracted from the Indian Creek data to account for natural flows resulting from precipitation and overland contributions. These values were then multiplied by the area ratio discussed above to estimate natural flows for each watershed. The Canteen Creek flows were further adjusted to account for the Collinsville STP which contributes 4.4 mgd to Canteen Creek upstream of the sampling location. Likewise, the Harding Ditch flows were adjusted to account for the Caseyville Township West STP which contributes 0.786 mgd to the watershed upstream of the sampling location.

7.2.2.2 Total Manganese Analysis for Canteen Creek Segment JNA01

A flow duration curve for segment JNA01 of Canteen Creek was generated by ranking the estimated daily flow data generated through the area ratio method discussed above, determining the percent of days these flows were exceeded, and then graphically plotting the results. The flows in the duration curve were then multiplied by the water quality standard of 1,000 µg/L for total manganese to generate a load duration curve. Total manganese data collected from USEPA STORET and Illinois EPA databases during Stage 1 of TMDL development were paired with the corresponding flow for the sampling date and plotted against the load duration curve. Figure 7-4 shows the load duration curve as a solid line and the observed pollutant load as points on the graph. Appendix G contains the spreadsheet used for this analysis.

The load duration curve shows that only two exceedences of the standard have occurred since 1990. One occurred under high-flow conditions and one occurred during low-flow conditions. Under average conditions, the standard is not being exceeded.

7.2.2.3 Fecal Coliform Analysis for Harding Ditch Segment JMAC02

A flow duration curve for segment JMAC02 of Harding Ditch was also generated by ranking the estimated daily flow data generated through the area ratio method discussed above, determining the percent of days these flows were exceeded, and then graphically plotting the results. Because the fecal coliform standard is seasonal and is only applicable between the months of May and October, only flows during this time period were used in the analysis. The flows in the duration curve were then multiplied by the geometric mean water quality standard of 200 cfu/100mL to generate a load duration curve. Fecal coliform data collected between May and October were compiled from USEPA STORET and Illinois EPA databases during Stage 1 of TMDL development and were paired with the corresponding flow for the sampling date and plotted against the load duration curve. Figure 7-5 shows the load duration curve as a solid line and the observed pollutant load as points on the graph. Appendix H contains the spreadsheet used for this analysis.

The load duration curve shows that only 1 of the 38 samples collected between May and October have been below the allowable load curve since 1990. The Illinois EPA 2004 303(d) list does not identify any potential sources of fecal coliform to Harding Ditch. The load duration analysis shows that the geometric mean standard of 200 cfu/100 mL is regularly exceeded during all flow scenarios and all samples collected during higher flow scenarios have exceeded the allowable levels. Exceedences during high flows are likely attributable to the fecal matter introduced to the stream via overland runoff and the resuspension of fecal material in the ditch sediment. Dry weather sources of fecal coliform likely include failing septic systems in the watershed and livestock with direct access to the ditch or its tributaries.

7.2.3 BATHTUB Development for Frank Holten Lakes

The BATHTUB model was used to develop the total phosphorus TMDL for the Frank Holten Lakes. Frank Holten Lakes 1, 2, and 3 are connected and were modeled as three segments of a contiguous waterbody. All of the Frank Holten Lakes are listed on the 2004 303(d) list for impairments caused by total phosphorus. In addition, Frank Holten Lake 3 has had two dissolved oxygen samples collected that were below the 5.0 mg/L instantaneous minimum standard. DO concentration in lakes is typically a response variable to constituents, such as phosphorus or chlorophyll "a." Chlorophyll "a" indicates presence of excessive algal or aquatic plant growth. The correlation between average DO and chlorophyll "a" is typically an inverse relationship whereas the correlation between chlorophyll "a" and average total phosphorus is typically a direct relationship. These relationships would suggest that controlling phosphorus will decrease chlorophyll "a" concentrations, which will in turn increase DO concentrations. This hypothesis is supported by Wetzel who asserts that eutrophic (nutrient-rich) lakes have rapid rates of oxygen depletion (1983). Reducing total phosphorus is likely to reduce algal growth thus resulting in attainment of the DO standard.

7.2.3.1 Operation of Frank Holten Lakes and Watershed Delineation

Frank Holten State Park contains three small lakes, Frank Holten Lake 1, 2, and 3. These lakes are the remains of an old oxbow lake of the Mississippi River. Lakes 1 and 2 together are commonly known as Whispering Willow Lake and Lake 3 is known as Grand Marais Lake. The lakes and the park are managed by the Illinois Department of Conservation (IDOC).

The Frank Holten Lakes consists of three distinct lakes as shown on Figure 7-7. Under normal conditions, Lake 1 flows into Lake 2, Lake 2 flows into Lake 3 via a connection channel, and then Lake 3 drains to Harding Ditch. The only connection between the lakes and Harding Ditch is at the outlet at the southern end of Lake 3. The connection channel and Harding Ditch are directed through culverts beneath I-255. There is no water level control at the outlet, and therefore during wet weather, when the water level in Harding Ditch is rising, it flows freely into Lake 3. When the water level in Harding Ditch is falling, Lake 3 flows freely into Harding Ditch. The area drained by Harding Ditch is 23,755 acres.

The area drained directly by the Frank Holten Lakes is approximately 3,300 acres. There are two sources of inflows into the Frank Holten Lakes:

- Stormwater runoff from surrounding residential sites
- Wet weather flows from Harding Ditch

Stormwater runoff from low-density residential areas and a high school discharges into Lake 1 via three drainage district culverts. Also, direct overland runoff from the other areas surrounding the lakes contributes flows to the lakes.

The modeling approach for the Frank Holten Lakes is based on two distinct "seasons"; a dry and a wet season. Two separate models have been developed, one for each season. The wet season includes March through May, the high flow portion of the year, when Harding Ditch can backflow into Lake 3. The dry season is defined as the other 9 months of the year, during which flows are lower.

7.2.3.2 Global Inputs

Global inputs represent the averaging period, precipitation, evaporation, and atmospheric contribution of phosphorus. The averaging period for the Frank Holten Lakes dry scenario is 9 months and the wet scenario is 3 months. Based on precipitation and evaporation rates discussed in the previous sections, the average annual precipitation received at Frank Holten Lakes is approximately 39.2 inches. Through the ISWS website, pan evaporation data are available from nine locations across Illinois (ISWS 2000). The Belleville station was chosen to be representative of pan evaporation conditions for the Frank Holten Lakes. The average monthly pan evaporation at the Belleville station for the years 1980 to 2002 (data was available for May-September) yields an average annual pan evaporation of 27 inches. Actual evaporation is typically less than pan evaporation, so the average annual pan evaporation was multiplied by 0.75 to calculate an average annual evaporation of 18 inches (ISWS 2007).

Precipitation and evaporation data from the corresponding wet (March through May) and dry (June through February) time periods were used for model inputs. The default atmospheric phosphorus deposition rate suggested in the BATHTUB model was used in absence of site-specific data, which is a value of 30 kg/km^2-yr (USACE 1999).

7.2.3.3 Reservoir Segment Inputs

Reservoir segment inputs in BATHTUB are used for physical characterization of the reservoir. The Frank Holten Lakes were modeled in 4 segments. The segment boundaries are shown on Figure 7-7. Segmentation was established based on available water quality and lake morphologic data.

Segment inputs to the model include average depth, segment length, and depth to the metalimnion. The lakes' depths were represented by the averaged data from the water quality stations. Depth data were presented in Section 5.2.2. Segment lengths were determined using GIS.

7.2.3.4 Tributary Inputs

Tributary inputs to BATHTUB include drainage area, flow, and total phosphorus (dissolved and solid-phase) loading. The drainage area of each tributary is equivalent to the basin or subbasin it represents, which was determined by reviewing the operations of the lake (see Section 7.2.4.1), land use data, aerial photography and GIS analyses. Table 7-4 is a summary of the subbasin characteristics.

Table 7-4 Frank Holten Lakes Subbasin Characteristics

Subbasin ID	Lake Segment Receiving Drainage	Subbasin Area (mi^2)	Estimated Flow (cfs)		Total Phosphorus (mg/L)	
			Dry Season	Wet Season	Dry Season	Wet Season
1	1	2.8	2.9	3.7	0.29	0.29
2	2	0.5	0.6	0.7	0.17	0.17
3	3	1.1	1.5	1.8	0.21	0.21
4	4	0.5	1.0	1.3	0.06	0.06
Harding Ditch Drainage Area[1]	4	41.0	N/A	46.6	N/A	0.44
Total		**46.0**	**6.0**	**54.1**	**0.73**	**1.17**

[1] Harding Ditch is diverted to Lake 3 during heavy rain events.

The model subbasins range in size from 0.5 to 41 square miles in area. The majority of Subbasin 1 is residential area, but it also includes a golf course adjacent to the Lake 1 and a high school to the north. Subbasin 2 is a mix of residential area, open space, and wetlands. The majority of Subbasin 3 is residential area. Subbasin 4 is mostly wetlands.

For the dry season scenario, Subbasins 1 through 4 are included in the model. For the wet season scenario, the Harding Ditch drainage area is also included in the model to represent the ditch backflow into Lake 3 during wet weather.

The Rational Method was used to estimate the runoff from each subbasin. The runoff coefficient and rainfall intensity used for the calculations were based on land use and the average monthly precipitation for the corresponding months for each season. The average wet and dry season flows for Harding Ditch were estimated were estimated using data from a surrogate gage located on Indian Creek in Wanda, Illinois (USGS 05588000). Based on depth and segment length information, the storage volume for Frank Holten Lakes was determined to be 1,783 ac-ft. Using inflow data and storage volume, the residence time was estimated for both scenarios.

Because no historic concentration data exist for Frank Holten Lakes' contributing subbasins, phosphorus loads from each subbasin in the lake were estimated based on land use data and the median event mean concentrations (EMCs) for each land use found in the *Results of the Nationwide Urban Runoff Program (NURP), 1983* report. The average wet season total phosphorus concentrations for Harding Ditch, available from water quality station JMAC02, were used in the model.

7.2.3.5 Frank Holten Lakes BATHTUB Confirmatory Analysis

Available historical lake water quality data are summarized in Section 5. These data were used to help confirm model calculations. The following setup was used in the BATHTUB Model:

- Conservative Substance Balance: Not computed
- Phosphorus Balance: 2nd Order, Available Phosphorus
- Nitrogen Balance: Not computed
- Chlorophyll-*a*: Not computed
- Longitudinal Dispersion: Fischer-Numeric
- Error Analysis: Model and data
- Phosphorus Calibration: Decay rates
- Nitrogen Calibration: None
- Application of Nutrient Availability Factors: Ignore
- Calculation of Mass Balances: Use estimated concentration

The loadings described above were entered into the BATHTUB model and compared with available water quality data for the lake. When using these loadings, the BATHTUB model under-predicted the concentrations when compared to actual water quality data. To achieve a better match with actual water quality data, internal loading rates were adjusted. Internal loading rates reflect nutrient recycling from bottom sediments. Based on the confirmatory analysis internal cycling is occurring in all segments of Frank Holten Lakes, but at a higher rate during the wet season. Table 7-5 shows the results of this analysis.

Table 7-5 Summary of Frank Holten Lakes Model Confirmatory Analyses

Scenario	Predicted TP Concentration (mg/L)	Observed TP Concentration (mg/L)	Internal Loading Rate (mg/m^2-day)
Dry Season	0.18	0.19	6.5
Wet Season	0.18	0.14	12

During the wet season, the predicted and observed concentration in the lake differs by approximately 28 percent. However, in Segments 1, 2 and 3, the percent difference is 3 percent or less. In Segment 4, where the Harding Ditch diversion occurs, the observed concentration is nearly 90 percent lower than the predicted concentration. As shown on Figure 7-5, the water quality station used for comparison is located at the very north end of Segment 4, very close to Segment 3. It is likely that this station does not monitor the impacts of the Harding Ditch diversion, which originates at the southern end of Segment 4.

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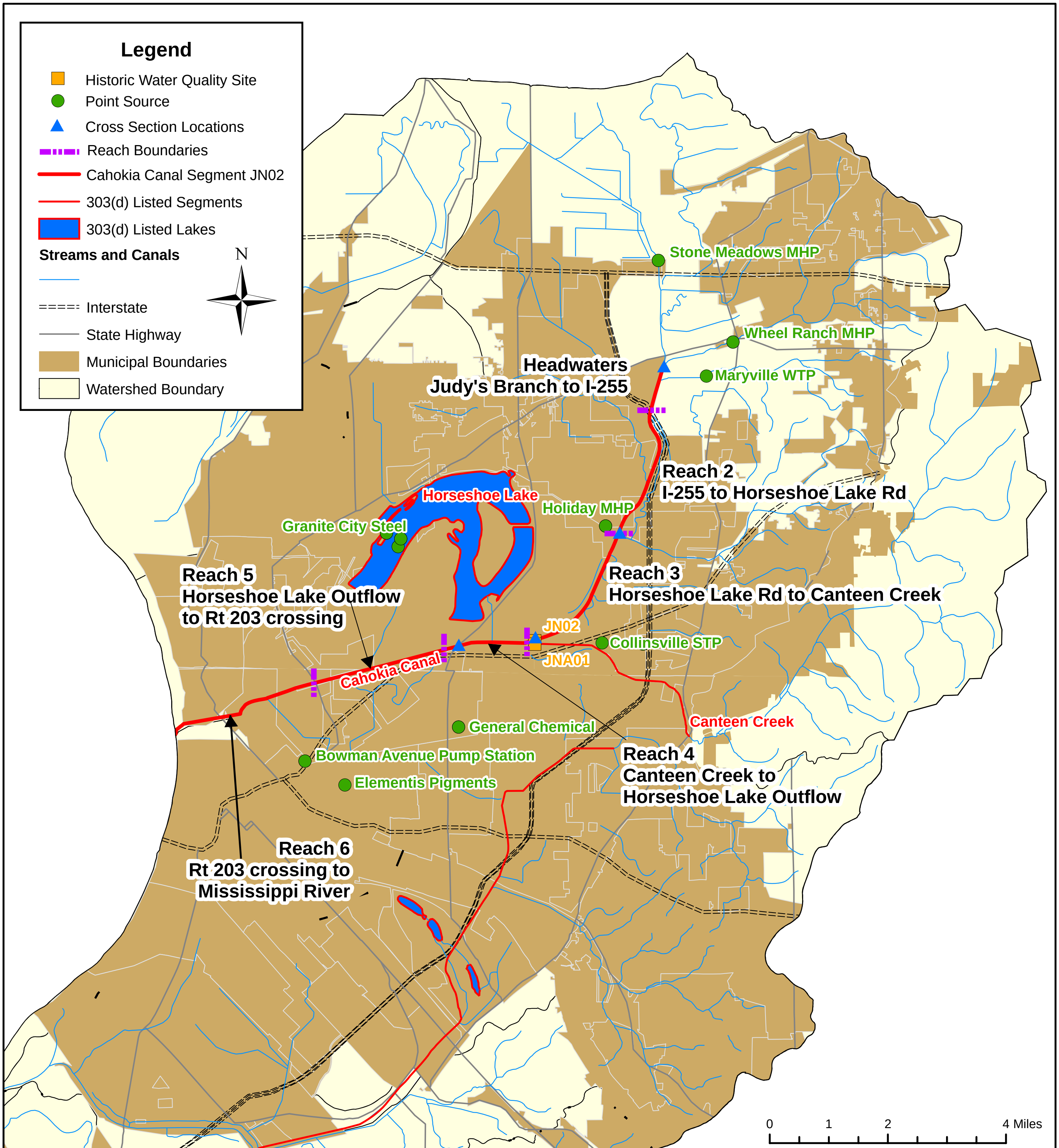

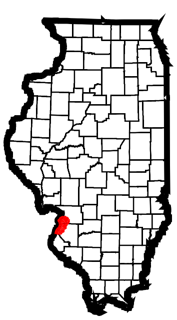

Figure 7-1
QUAL2K Segmentation
Cahokia Canal

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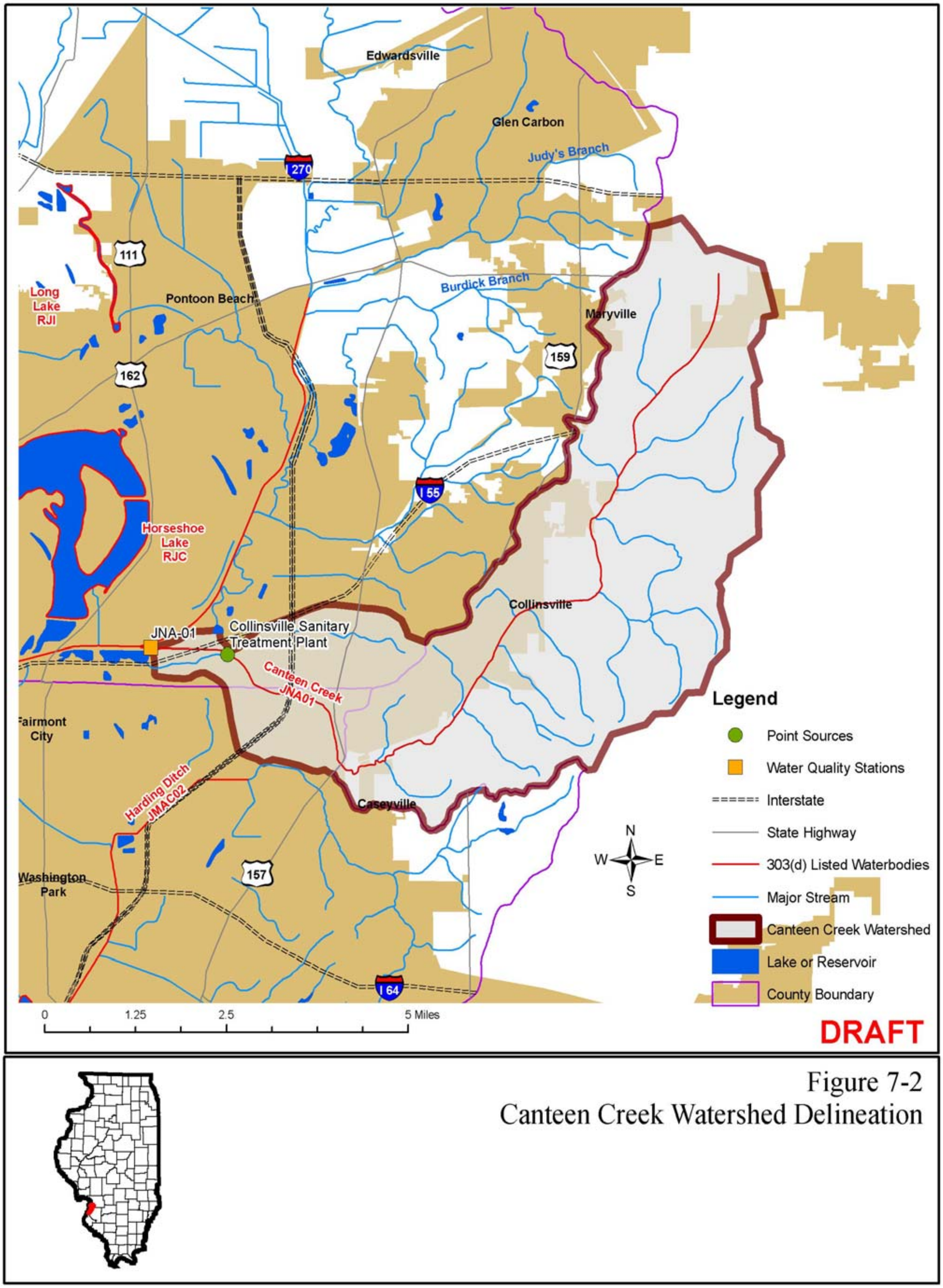

Figure 7-2
Canteen Creek Watershed Delineation

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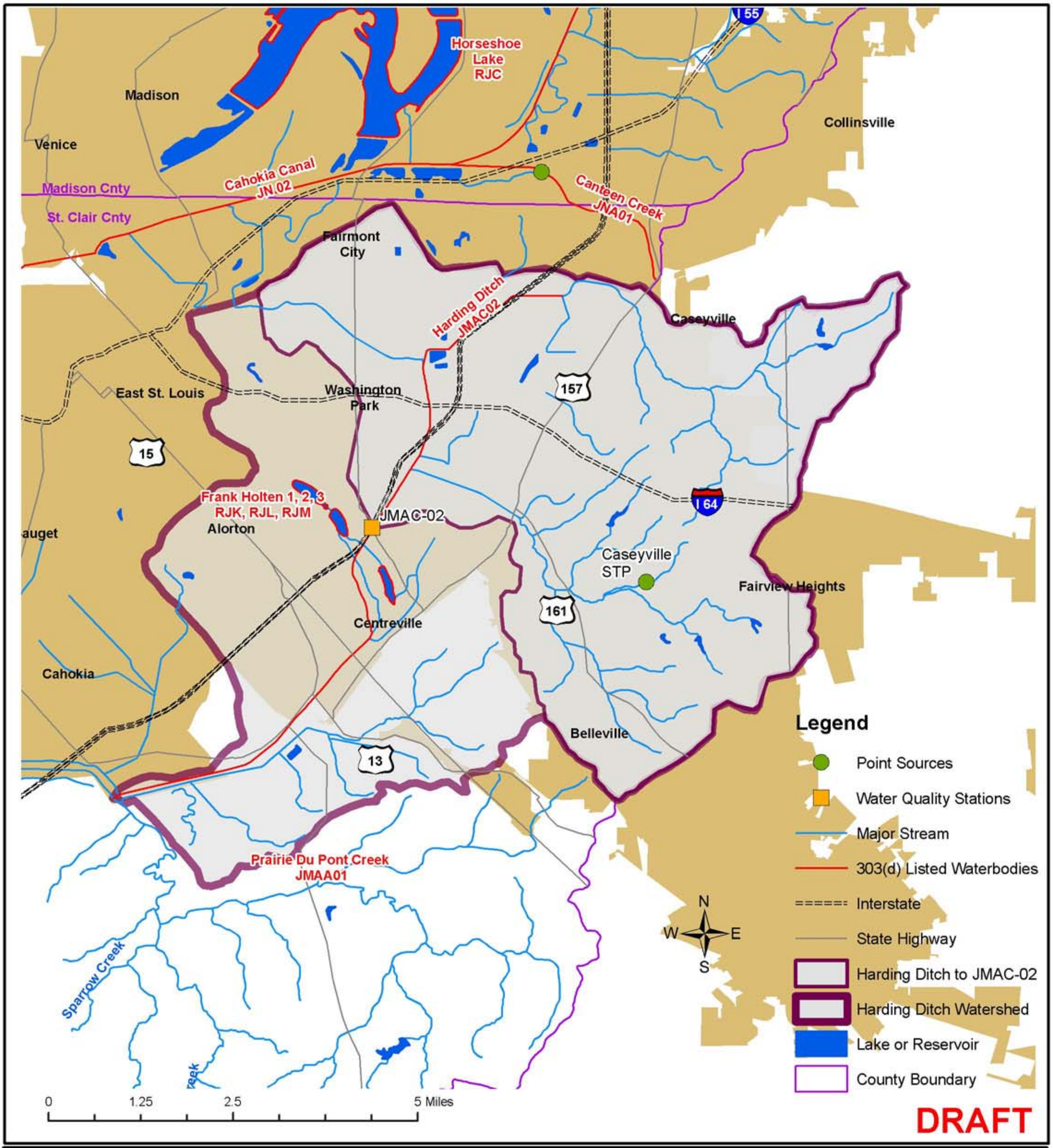

Figure 7-3
Harding Ditch Watershed Delineation

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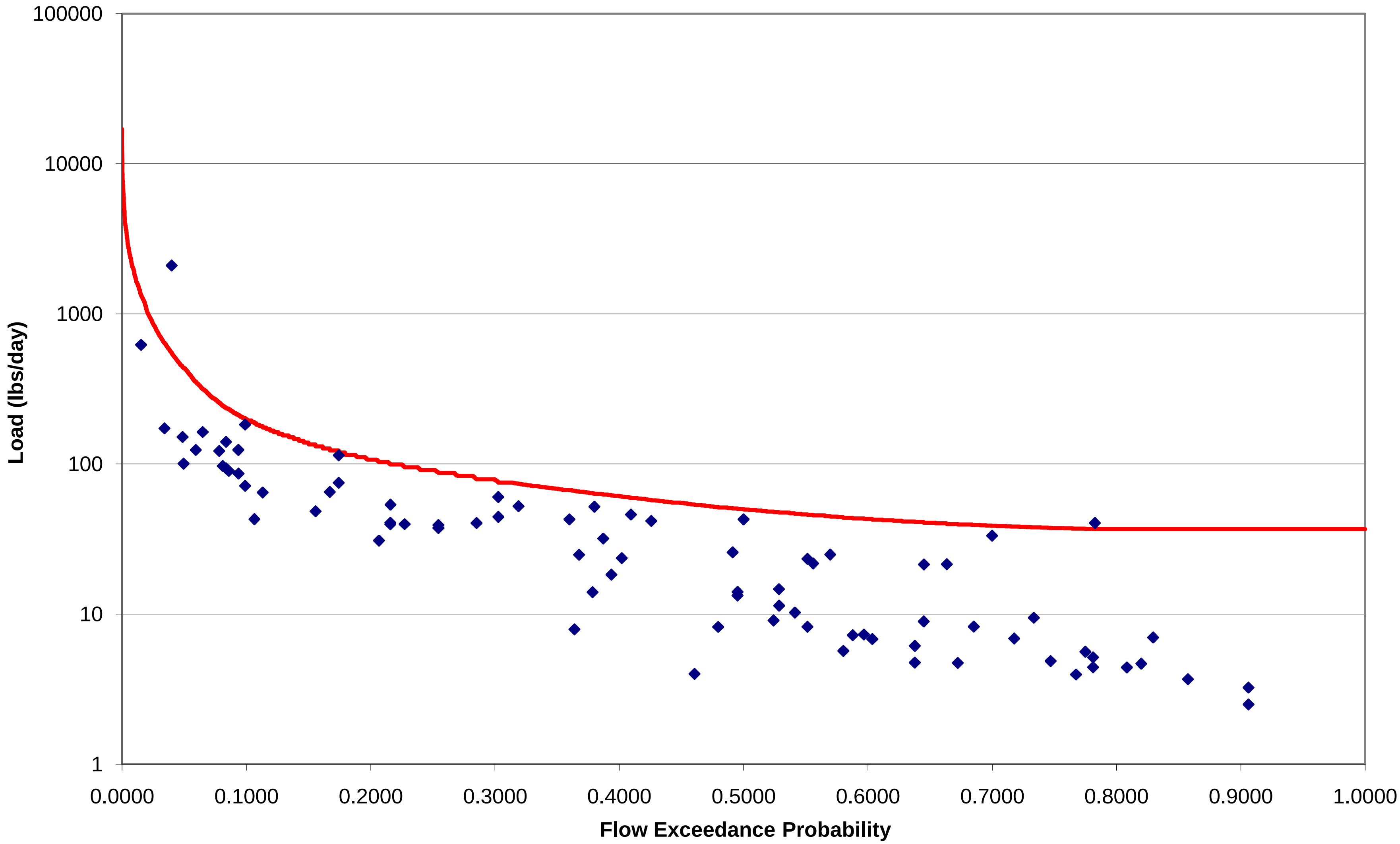

CDM

Figure 7-4: Manganese Load Duration Series for Canteen Creek

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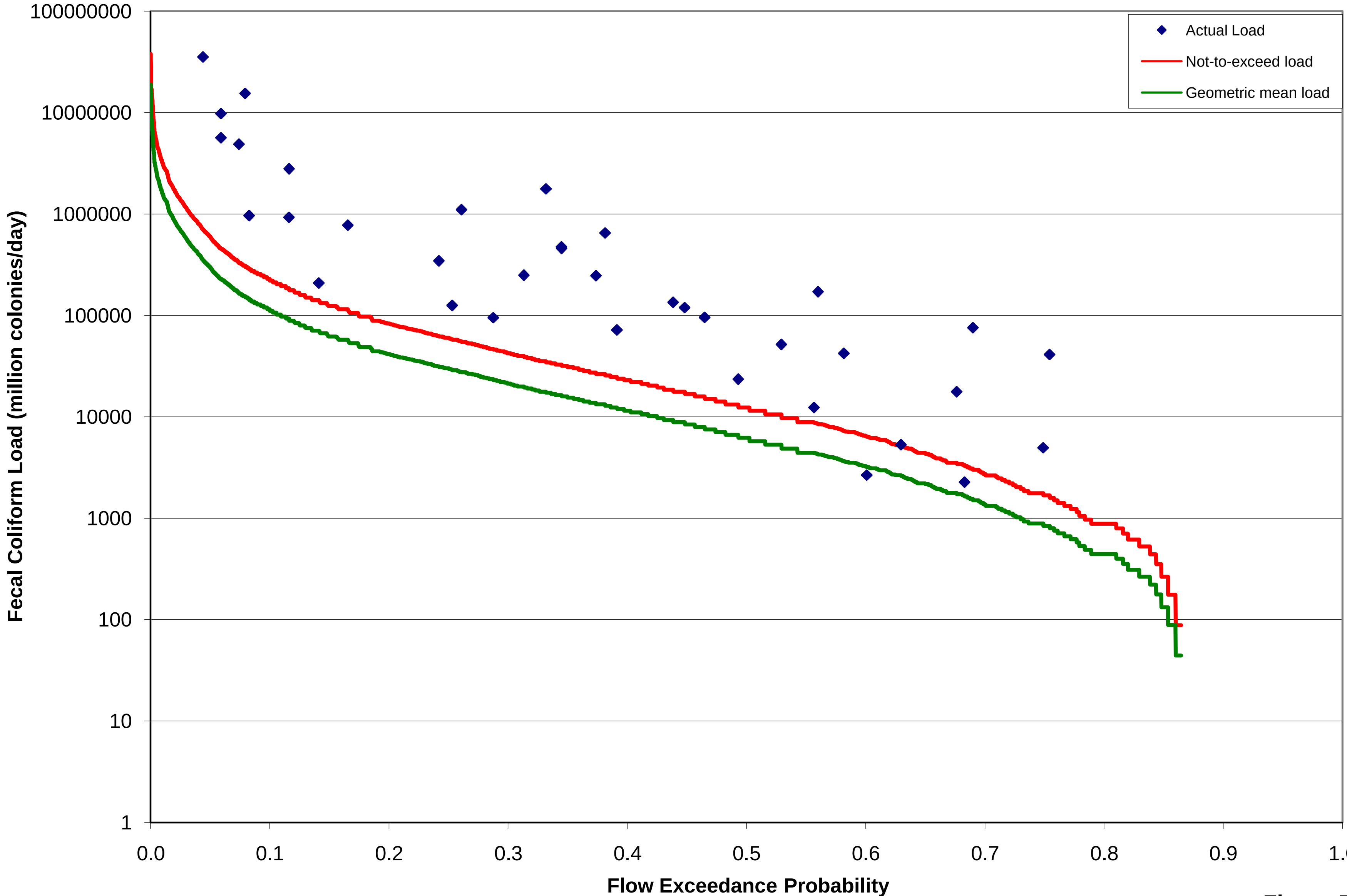

Figure 7-5:
Fecal Coliform Load Duration Curve for Harding Ditch

CDM

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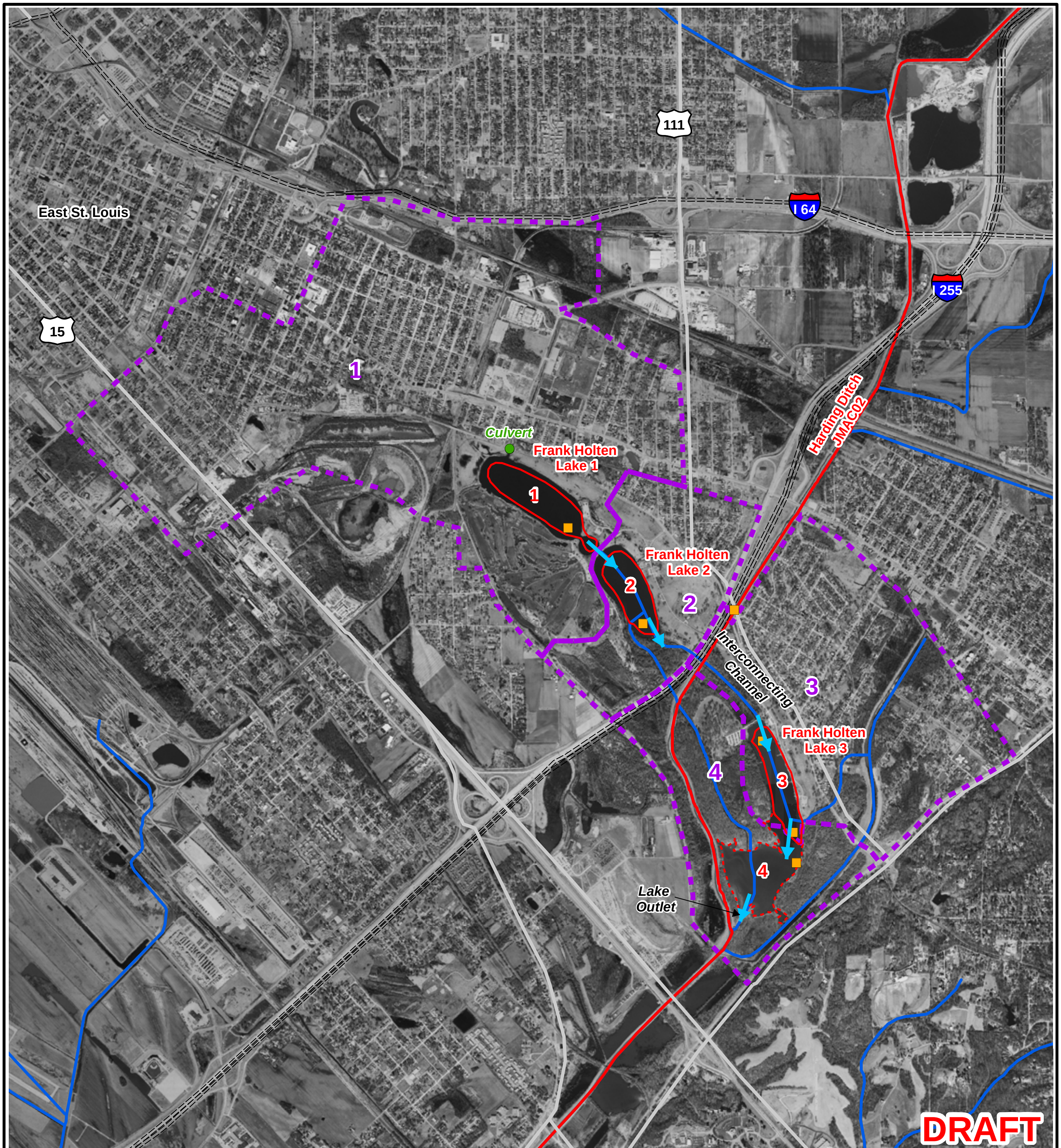

Interstate
US and State Highway
County Boundary
303(d) Listed Waterbody
Major Stream
Watershed
Lake or Reservoir
Water Quality Station
Part of Lake 3
FrankHoltenLk_subws
Lake Flow
Inflow
Segmented_FrankHoltenLks_Prj

Figure 7-7. Frank Holten Lakes BATHTUB Schematic

N W E S

0 0.5 1 2 Miles

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Section 8
Total Maximum Daily Loads for the Cahokia Canal Watershed

8.1 TMDL Endpoints

The TMDL endpoints for DO, manganese, fecal coliform and total phosphorus for the impaired segments in the Cahokia Canal watershed are summarized in Table 8-1. All concentrations must be below the TMDL endpoints except for DO concentrations which need to be above 6.0 mg/L during 16 hours of any 24 hour period and must never go below 5.0 mg/L. The endpoints are based on the protection of aquatic life in Canteen Creek and the Frank Holten Lakes and the protection of the recreational uses of Harding Ditch. Some of the average concentrations, which are based on data sets discussed in Section 5, meet the desired endpoints. However, each data set has maximum or minimum values, again, presented in Section 5, that do not meet the desired endpoints and this was the basis for TMDL analysis. Further monitoring as outlined in the monitoring plan presented in Section 9, will help further define when impairments are occurring in the watershed and support the TMDL allocations outlined in the remainder of this section.

Table 8-1: TMDL Endpoints and Average Observed Concentrations for Impaired Constituents in the Cahokia Canal Watershed

Impaired Segment	Constituent	TMDL Endpoint	Average Observed Value on Impaired Segment
Canteen Creek JNA01	Manganese	1,000 ug/L	423 ug/L
Harding Ditch JMAC02	Fecal Coliform	400 cfu/100 mL during October - May	2,454 cfu/mL (geometric mean)
Cahokia Canal JN02	DO	6.0 mg/L (16 hours of any 24-hour period), 5.0 mg/L instantaneous minimum	8.2 mg/L
Frank Holten Lakes RJK, RJL, and RJM	Total Phosphorus	0.05 mg/L	0.17 mg/L

8.2 Pollutant Source and Linkage

Potential pollutant sources for the impaired waterbodies in the Cahokia Canal watershed were identified through the existing data review described in sections 1 through 5 and the TMDL methodologies discussed and presented in sections 6 and 7. The source of manganese in Canteen Creek is most likely natural sources. Area soils, naturally high in manganese (see discussion in Section 2.4.1), erode into the creek through weathering. Once these manganese rich soils accumulate in the creek, low oxygen levels release the metals into the water column. The likely cause of low dissolved oxygen concentrations seen in Cahokia Canal are slow-moving waters and increased water temperatures that promote algal growth. Sources of fecal coliform to Harding Ditch during high flows are likely attributable to the fecal matter introduced to the stream via overland runoff and the resuspension of fecal material in the ditch sediment. Dry weather sources of fecal coliform likely include failing septic systems in the watershed and livestock with direct access to the ditch or its tributaries. Nutrient sources to the Frank Holten Lakes are dominated by wet weather nonpoint sources.

8.3 Allocation

As explained in Section 1, the TMDLs for the impaired segments in the Cahokia Canal watershed will address the following equation:

$$\textbf{TMDL = LC = } \Sigma \textbf{WLA + } \Sigma \textbf{LA + MOS}$$

where:

where:	LC	=	Maximum amount of pollutant loading a water body can receive without violating water quality standards
	WLA	=	The portion of the TMDL allocated to existing or future point sources
	LA	=	Portion of the TMDL allocated to existing or future nonpoint sources and natural background
	MOS	=	An accounting of uncertainty about the relationship between pollutant loads and receiving water quality

Each of these elements will be discussed in this section as well as consideration of seasonal variation in the TMDL calculation.

8.3.1 Cahokia Canal DO TMDL

8.3.1.1 Loading Capacity

The LC is the maximum amount of oxygen-demanding material that Cahokia Canal can receive and still maintain compliance with the water quality standards. The allowable loads of oxygen-demanding material that can be generated in the watershed and still maintain water quality standards were determined with the methodology discussed in Section 7.2.1.

In the absence of a reasonable measured calibration data set, model dissolved oxygen forcing variables were adjusted to achieve reasonable values based on limited site-specific data (e.g. hydraulics, water temperature) and literature/experience (e.g. SOD, benthic algae, phytoplankton). Model internal rates were maintained at default (recommended) values. Results show that re-aeration dominates over oxidation in the target reach for the assumed loading conditions and kinetic rates.

Based on model analysis, flow and reaeration would need to be increased during summer months. Because a TMDL can not be developed for reaeration, no TMDL will be developed at this time.

Further monitoring and implementation measures to increase aeration in the system are discussed in Section 9.

8.3.2 Canteen Creek Manganese TMDL

8.3.2.1 Loading Capacity

The LC is the maximum amount of manganese that Canteen Creek can receive and still maintain compliance with the water quality standards. The allowable manganese loads that can be generated in the watershed and still maintain water quality standards were determined with the methodology discussed in Section 7.2.2. The manganese loading capacity according to flow is presented in Table 8-2.

Table 8-2: Manganese Loading Capacity for Canteen Creek Segment JNA01

Estimated Mean Daily Flow (cfs)	Load Capacity (lbs/day)
7	38
15	81
30	160
50	267
100	541
200	1081
400	2152
1000	5394

The mean of the two exceedences on Canteen Creek was calculated and compared to the manganese standard of 1,000 µg/L. The mean of the exceedences was 2,450 µg/L. By comparing this value to the water quality standard, it was determined that a 59 percent reduction is needed to meet the standard.

8.3.2.2 Seasonal Variation

Consideration to seasonality is inherent in the load duration. The standard is not seasonal and the full range of expected flows is represented. Therefore, the loading capacity represents conditions throughout the year. In addition, the critical condition must be considered. Critical conditions refer to the periods when greatest reductions of pollutants are needed with respect to flow, load and water quality. The load duration curve showed that the critical condition for manganese occurs during high flow conditions. Both stormwater point and nonpoint sources are believed to contribute to manganese loads during this critical period. The allocation of point source loads (WLAs) and reduction strategies for nonpoint sources presented in the implementation plan (Section 9) will mitigate the critical condition for manganese on Canteen Creek.

8.3.2.3 Margin of Safety

The MOS can be implicit (incorporated into the TMDL analysis through conservative assumptions) or explicit (expressed in the TMDL as a portion of the loadings) or a combination of both. The TMDL developed for Canteen Creek contains an explicit MOS of 5 percent. The five percent MOS is included to account for the low uncertainty associated with the number of available data points in the load duration analysis and the flow estimations used to build the load duration curve.

8.3.2.4 Waste Load Allocation

There is one municipal point source and two MS4s that discharge to Canteen Creek. The average discharge from the Collinsville STP is 4.41 mgd, or an average of 6.8 cfs. This facility is not believed to contribute significantly to manganese concentrations in Canteen Creek and therefore, the WLA for this facility was set to zero. The City of Collinsville and the Township of Caseyville MS4 permits lists Canteen Creek as their receiving water. A landuse evaluation was performed to determine the percent of the watershed that is urban (high, medium or low density residential). Thirty-eight percent of the watershed is classified as residential and it is estimated that this portion of the watershed is covered by the MS4 permits. The WLA for the City of Collinsville (ILR400316) and the Township of Caseyville (ILR400316) MS4 permits was set to 38% of the LC during high flow conditions.

8.3.2.5 Load Allocation and TMDL Summary

As discussed in Section 8.3.2.1, the load duration analysis determined that a 59% reduction in manganese loading is needed to meet the water quality standard of 1,000 µg/L. Table 8-3 shows a summary of the TMDL for Canteen Creek.

Table 8-3: TMDL Summary for Manganese in Canteen Creek

Estimated Mean Daily Flow (cfs)	LC (lb/d)	WLA (lb/d)	LA (lb/d)	MOS (lb/d)
7	38	0	36	2
15	81	0	77	4
30	160	0	152	8
50	267	101	152	13
100	541	206	308	27
200	1081	411	616	54
400	2152	818	1227	108
1000	5394	2050	3075	270

8.3.3 Harding Ditch Fecal Coliform TMDL

8.3.3.1 Loading Capacity

The LC is the maximum amount of fecal coliform that Harding Ditch can receive and still maintain compliance with the water quality standards. The allowable fecal coliform loads that can be generated in the watershed and still maintain the geometric mean standard of 200 cfu/100mL were determined with the methodology discussed in Section 7.2.2. The fecal coliform loading capacity according to flow is presented in Table 8-4.

Table 8-4: Fecal Coliform Loading Capacity

Mean Daily Flow (cfs)	Geometric Mean Load Capacity (mil col/day)
5	24,300
10	44,200
20	88,400
50	221,000
100	442,000
200	884,000
500	2,200,000
1000	4,420,000

The mean of all the exceedences recorded on Harding Ditch was calculated and compared to the geometric mean fecal coliform standard of 200 cfu/100 mL. The mean of the exceedences was 5,210 cfu/100mL. By comparing this value to the water quality standard, it was determined that a 96 percent reduction is needed to meet the standard.

8.3.3.2 Seasonal Variation

Consideration of seasonality is inherent in the load duration analysis. Because the load duration analysis represents the range of expected stream flows, the TMDL has been calculated to meet the standard during all flow conditions. In addition, seasonality is addressed because the TMDL has been calculated to address loading only when the seasonal standard is applicable (May through October).

For this TMDL, the critical period for fecal coliform is the primary contact recreation season which is May through October each year. There is no one critical condition during the recreation season. The fecal coliform standard must be met under all flow scenarios and standard exceedances have occurred during all flow scenarios. By using the load duration curve method, all of these "critical conditions" are accounted for in the loading allocations.

8.3.3.3 Margin of Safety

The margin of safety (MOS) can be implicit (incorporated into the TMDL analysis through conservative assumptions) or explicit (expressed in the TMDL as a portion of the loadings) or a combination of both. The MOS for the Harding Ditch TMDL includes an implicit MOS because the more stringent standard of 200 cfu/100mL was used in the analysis as a not to exceed value rather than a geometric mean. In addition, the analysis did not consider the die-off of bacteria, which is likely occurring within the stream system causing the analysis to overestimate instream values.

8.3.3.4 Waste Load Allocation

There is one municipal point source which discharges within the Harding Ditch watershed. The MS4 for Caseyville Township lists Canteen Creek as its receiving water and was therefore not considered in this analysis. The Caseyville Township West STP discharges to Clare Creek which is a tributary of Harding Ditch. The permitted discharge from the facility is 0.786 mgd, or 1.2 cfs. The discharge has a fecal coliform limit of 400 cfu/100 mL and DMR records show that the actual average fecal coliform in the facility's effluent is approximately 138 cfu/100 mL or a load of 3,660 million col/day. The Caseyville Township West STP is not considered to be a significant contributor of fecal coliform load to Harding Ditch. The WLA for Caseyville Township is based on the facility's design average flow of 0.786 mgd multiplied by the fecal coliform limit of 400 cfu/100mL. The WLA was determined to be 11,744 million colonies per day and is applicable during each day of the recreation season.

8.3.3.5 Load Allocation and TMDL Summary

The load duration analysis described in Section 8.3.3.1 determined that a 96 percent reduction in fecal coliform loading needs to occur in order to meet the geometric mean instream water quality standard of 200 cfu/100 mL. The LA was determined by subtracting the WLA from the LC. Table 8-5 shows a summary of the TMDL for Harding Ditch.

Table 8-5 TMDL Summary for Fecal Coliform in Harding Ditch

Estimated Mean Daily Flow (cfs)	LC (mil col/d)	WLA (mil col/d)	LA (mil col/d)	MOS (mil col/d)
5	24,300	11,744	12,556	implicit
10	44,200	11,744	32,456	implicit
20	88,400	11,744	76,656	implicit
50	221,000	11,744	209,256	implicit
100	442,000	11,744	430,256	implicit
200	884,000	11,744	872,256	implicit

500	2,200,000	11,744	2,188,256	implicit
1000	4,420,000	11,744	4,408,256	implicit

8.3.4 Frank Holten Lakes Total Phosphorus TMDL

8.3.4.1 Loading Capacity

The loading capacity of the Frank Holten Lakes is the total mass of phosphorus that can be assimilated by the lake and still meet the water quality standard of 0.05 mg/L total phosphorus. The allowable phosphorus loads that can be generated in the watershed and still maintain water quality standards were determined with the models that were set up and calibrated as discussed in section 7.2.3. To accomplish this, modeled phosphorus loads were reduced by a percentage and entered into the BATHTUB model until the water quality standard of 0.05-mg/L total phosphorus was met in the Frank Holten Lakes. The allowable phosphorus load was determined to be **0.2 lbs/day** during the dry season and **11.5 lbs/day** during the wet season. A spreadsheet of this analysis is included as Appendix J.

8.3.4.2 Seasonal Variation

Seasonal variation in lake water quality is captured in the Frank Holten Lakes TMDL by both wet and dry seasons. The wet scenario is characterized by higher loadings, higher dilution, and lower water temperatures. Loadings are higher in this wet season scenario due to increased runoff and the back flow of Harding Ditch into Frank Holten Lake #3. The summer scenario is characterized by higher water temperatures and lower dilution. The loadings for this TMDL are presented as daily amounts allowable during dry and wet seasons. Critical conditions are occurring during both scenarios with high flows and loads in the wet season and high concentrations associated with algal blooms in the summer season. Because the TMDL includes loading during both scenarios, it is assumed that the critical condition is accounted for within the analysis.

8.3.4.3 Margin of Safety

The MOS can be implicit (incorporated into the TMDL analysis through conservative assumptions) or explicit (expressed in the TMDL as a portion of the loadings) or a combination of both. The MOS for the Frank Holten Lakes TMDL is implicit. The analysis completed for the lakes is conservative because of the following:

- Default values were used in the BATHTUB model, which in absence of site-specific information are assumed conservative. Default model values, such as the phosphorus assimilation rate, are based on scientific data accumulated from a large survey of lakes. Because no site-specific data are available, default model rates are used which are based on error analysis calculations. The model used for this analysis uses estimates of second-order sedimentation coefficients which are generally accurate to within a factor of 2 for phosphorusn. This provides a conservation range of where the predictions could fall and provides confidence in the predicted values.

- Because site-specific data were not available on internal cycling rates, conservative estimates were used based on available in-lake concentration data and predicted concentrations in the absence of internal loading. The model is set up with default rates but allows user-input of more conservative estimates of internal loading which result in the model achieving a close estimate of in-lake concentration data for the average-loading conditions modeled in this scenario.

- In the absence of site-specific data, an atmospheric loading rate of 30 mg/m2-yr total phosphorus (USACE 1999) was taken from literature values and assumed in the BATHTUB model. This is a conservative value because atmospheric loadings of phosphorus are attributed to erosion that becomes wind borne and because of the low agricultural activity in the watershed the atmospheric loading is most likely negligible.

8.3.4.4 Waste Load Allocation

No MS4 permits discharge to receiving waters in the Frank Holten Lakes drainage. There is one municipal point source located in the Harding Ditch subbasin, however, it is located on a tributary to Harding Ditch and is significantly upstream of the lakes. Because point sources are not influencing nutrient levels in the lakes, the WLA is set to zero.

8.3.4.5 Load Allocation and TMDL Summary

Tables 8-7 and 8-8 show a summary of the TMDLs for the Frank Holten Lakes. On average, a total reduction of total phosphorus loads to the lake of 92 percent during the dry season and 88 percent during the wet season would result in compliance with the water quality standard of 0.05 mg/L total phosphorus.

Table 8-7 TMDL Summary for Total Phosphorus in Frank Holten Lakes- Dry Season

Load Source	Estimated Current Load (lb/day)	LC (lb/day)	WLA (lb/day)	LA (lb/day)	MOS (lb/day)	Reduction Needed (lb/day)	Reduction Needed (percent)
Total	2.4	0.2	0	0.2	implicit	2.2	92
Internal	2.3	0.1	0	0.1	implicit	2.2	96
External	0.1	0.1	0	0.1	implicit	0	0

Table 8-8 TMDL Summary for Total Phosphorus in Frank Holten Lakes- Wet Season

Load Source	Estimated Current Load (lb/day)	LC (lb/day)	WLA (lb/day)	LA (lb/day)	MOS (lb/day)	Reduction Needed (lb/day)	Reduction Needed (percent)
Total	95.9	11.5	0	11.5	implicit	84.3	88
Internal	4.2	0.4	0	0.4	implicit	3.8	90
External	91.7	11.1	0	11.1	implicit	80.5	88

Section 9
Implementation Plan for the Cahokia Canal Watershed

9.1 Adaptive Management

An adaptive management or phased approach is recommended for the TMDLs developed for the Cahokia Canal watershed due to the limited amount of data available for the TMDL analysis. Adaptive management is a systematic process for continually improving management policies and practices through learning from the outcomes of operational programs. Some of the differentiating characteristics of adaptive management are:

- Acknowledgement of uncertainty about what policy or practice is "best" for the particular management issue
- Thoughtful selection of the policies or practices to be applied (the assessment and design stages of the cycle)
- Careful implementation of a plan of action designed to reveal the critical knowledge that is currently lacking
- Monitoring of key response indicators
- Analysis of the management outcomes in consideration of the original objectives and incorporation of the results into future decisions (British Columbia Ministry of Forests 2000)

Implementation actions, point source controls, management measures, or BMPs are used to control the generation or distribution of pollutants. BMPs are either structural, such as wetlands, sediment basins, fencing, or filter strips; or managerial, such as conservation tillage, nutrient management plans, or crop rotation. Both types require good management to be effective in reducing pollutant loading to water resources (Osmond et al. 1995).

It is generally more effective to install a combination of point source controls and BMPs or a BMP system. A BMP system is a combination of two or more individual BMPs that are used to control a pollutant from the same critical source. In other words, if the watershed has more than one identified pollutant, but the transport mechanism is the same, then a BMP system that establishes controls for the transport mechanism can be employed (Osmond et al. 1995).

To assist in adaptive management, implementation actions, management measures, available assistance programs, and recommended continued monitoring are all discussed throughout the remainder of this section.

9.2 Implementation Actions and Management Measures for DO in the Cahokia Canal

A number of potential sources of oxygen-demanding material were identified through Stages 1 and 3 of TMDL development. Modeling determined that low flows and high temperatures are driving the low levels of DO recorded on the segment. Oxygen-demanding materials in the canal sediments consume oxygen during these low flow times. Potential contributors to oxygen-demanding materials in the impaired segment include include nonpoint sources (crop fertilization, lawn fertilization, and streambank erosion) as well as point sources contributions in the watershed.

9.2.1 Point Sources of Oxygen-Demanding Materials

A DO TMDL for Cahokia Canal was not developed, however, a review of potential contributors of oxygen-demanding materials was performed for this implementation plan so that information on all potential sources are available to the community for any future monitoring or remediation work performed within the watershed.

9.2.1.1 Stormwater Sources

Portions of the Cahokia Canal watershed are dominated by urban land uses. Within the canal's watershed, the following municipalities have stormwater permits:

- Edwardsville
- Glen Carbon
- Pontoon Beach
- Maryville
- Granite City
- Collinsville
- Madison
- Venice
- East St. Louis
- Caseyville

Illinois MS4 permits require that six minimum controls be implemented to reduce pollutants discharged. The minimum controls are:

- Public Education/Outreach
- Public Participation/Involvement
- Illicit Discharge Detection/Elimination
- Construction Site Runoff Control
- Post Construction Runoff Control
- Pollution Prevention/Good Housekeeping

These six controls should result in stormwater quality that does not affect the loads of oxygen-demanding material to the canal. Future monitoring of stormwater outfalls will help determine the efficiency of the six minimum stormwater controls and will help to gage the contributions of oxygen-demanding materials from urban storm sewers. The permitting section of Illinois EPA has the authority to review stormwater permits.

9.2.1.2 Municipal/Industrial Sources

There are a number of point sources within the Cahokia Canal watershed that contribute oxygen-demanding materials to the canal (see Figure 7-1).

WLAs were not developed because the modeling determined that low flows, rather than point source contributions, were impairing the segment. Tables 9-1 and 9-2 estimate the actual loads of $CBOD_5$ and ammonia being discharged based on average values from recent DMR records available through USEPA's PCS. This analysis was not performed for organic nitrogen because there are no permit limits for the parameter and as a result, there are no DMR data available to use for an estimated load. It is recommended that monitoring be continued for DO, $CBOD_5$ and ammonia and that future monitoring be performed for organic nitrogen in effluent discharged within this watershed. Should new information and/or more data become available, the QUAL2K model for this segment could be updated.

Table 9-1 Current Estimated $CBOD_5$ Load

Facility Name	Average Flow (mgd)	Average CBOD5 (mg/L)	Current Load (lbs/day)	Maximum Permitted Load (lbs/day)
Stone Meadows MHP	0.03	4.0	1.2	29
Holiday MHP	0.03	7.56	2.05	21
Collinsville STP	3.35	1.8	54	1251

Table 9-2 Current Estimated Ammonia Load

Facility Name	Average Flow (mgd)	Average ammonia (mg/L)	Current Load (lbs/day)	Maximum Permitted Load(1) (lbs/day)
Stone Meadows MHP	0.03	0.93	0.23	4.4-12
Holiday MHP	0.03	1.43	0.31	3.1-8.3
Collinsville STP	3.35	0.22	6.6	188-475
Elementis Pigments	0.7	1.02	6	NA

(1) Ammonia Permit Limits are seasonal

Illinois EPA will evaluate the need for point source controls through the NPDES permitting program as each permit is due for renewal. Table 9-3 contains permit expiration dates for the facilities discharging within the Cahokia Canal watershed.

Table 9-3 Permit Expiration Dates for Point Source Discharges within the Cahokia Canal Watershed

Facility Name	Permit Number	Permit Issued	Permit Expires
Stone Meadows MHP	IL0046914	Jan. 20, 2005	Feb. 28, 2010
Holiday MHP	IL0038288	Oct. 28, 2005	Nov. 30, 2010
Collinsville STP	IL0028215	Oct. 6, 2005	Nov. 30, 2010
General Chemical	IL0000647	Apr. 23, 2008	Mar. 31, 2008
Elementis Pigments	IL0038709	Jan. 24, 2006	Feb. 28, 2011
Bowman Avenue Pump Station	IL0070955	Dec. 18, 2002	Dec. 31, 2007

9.2.2 Nonpoint Sources of Oxygen-Demanding Materials

In addition to point sources of oxygen-demanding materials within the watershed, there are a number or potential nonpoint sources. The potential sources of nonpoint pollution to the Cahokia Canal include overfertilization, streambank erosion, low flows, and high temperatures. BMPs evaluated for treatment of these nonpoint sources are:

- Filter strips
- Reaeration/Erosion Control/Streambank Stabilization

Organic and nutrient loads originating from cropland are most efficiently treated with a combination of riparian buffer or grass filter strips. Streambank stabilization and erosion control can limit the oxygen-demanding material entering the stream. Instream management measures for DO focus on reaeration techniques. The Q2K model used to develop the TMDL utilizes reaeration coefficients. Increasing the reaeration coefficient by physical means will increase DO in the Cahokia Canal.

9.2.2.1 Filter Strips

Filter strips can be used as a control to reduce pollutant loads, including nutrients and sediment, to the Cahokia Canal. Filter strips implemented along stream segments slow and filter nutrients and sediment out of runoff, help reduce stream water temperatures thereby increasing the water body DO saturation level, and provide bank stabilization decreasing erosion and deposition. The following paragraphs focus on the implementation of filter strips in the Cahokia Canal watershed. Finally, design criteria and size selection of filter strips are detailed.

Organic debris in topsoil contributes to the $CBOD_5$ load to water bodies (USEPA 1997). Increasing the length of stream bordered by grass and riparian buffer strips will decrease the amount of $CBOD_5$ and nutrient load associated with sediment loads to the Cahokia Canal. Nutrient criteria, currently being developed and expected to be adopted in the near future by the Illinois EPA, will assess the instream nutrient concentrations required for the watershed. Excess nutrients in streams can cause excessive algal growth, which can deplete DO in streams. Adoption of nutrient criteria will potentially affect this DO TMDL and help control exceedences of DO water quality criteria in the Cahokia Canal.

Filter strips will help control $CBOD_5$ levels by removing organic loads associated with sediment from runoff; however, no studies were identified as providing an estimate of removal efficiency. Grass filter strips can remove as much as 75 percent of sediment and 45 percent of total phosphorus from runoff, so it is assumed that the removal of $CBOD_5$ falls within this range (NCSU 2000). Riparian buffer strips also help reduce water temperatures which can in turn increase the water body DO saturation level.

Riparian vegetation, specifically shade, plays a significant role in controlling stream temperature change. The shade provided will reduce solar radiation loading to the stream. Furthermore, riparian vegetation provides bank stability that reduces sediment loading to the stream and the stream width-to-depth ratio. Research in California (Ledwith 1996), Washington (Dong et al. 1998), and Maine (Hagan and Whitman 2000) has shown that riparian buffers effect microclimate factors such as air temperature and relative humidity proximal to the stream. Ledwith (1996) found that a 500-foot buffer had an air temperature decrease of 12°F at the stream over a zero-foot buffer. The greatest change occurred in the first 100 feet of the 500-foot buffer where the temperature decreased 2°F per 30 feet from the stream bank. A decrease in the air temperature proximal to the stream would result in a smaller convective flux to the stream during the day.

Filter strip widths for the Cahokia Canal TMDL were estimated based on the land slope. According to the NRCS Planning and Design Manual, the majority of sediment is removed in the first 25 percent of the width (NRCS 1994). Table 9-4 outlines the guidance for filter strip flow length by slope (NRCS 1999).

Table 9-4 Filter Strip Flow Lengths Based on Land Slope

Percent Slope	0.5%	1.0%	2.0%	3.0%	4.0%	5.0% or greater
Minimum	36	54	72	90	108	117
Maximum	72	108	144	180	216	234

GIS land use data described in Section 5 were used in conjunction with soil slope data to provide an estimate of acreage where filter strips could be installed. As discussed in Section 2.4.1, the most predominant soil type in the watershed is Darwin Silty Clay on 0 to 2 percent slopes. Based on these slope values, filter strip widths of 36 to 144 feet could be incorporated into agricultural lands adjacent to canal and its tributaries. Mapping software was then used to buffer stream segments to determine the total area found within 144 feet of tributaries in the watershed. There are approximately 1,730 total acres within this buffer distance. The land use data were then clipped to the buffer area to determine the amount of this land that is agricultural. There are an estimated 360 acres of agricultural land in the upper reaches of the Cahokia Canal watershed that could potentially be converted to filter strips (see Figure 9-1). Landowners should evaluate their land near the Cahokia Canal and its tributaries and create or extend filter strips according to the NRCS guidance provided in Table 9-4. Programs available to fund the construction of these buffer strips are discussed in Section 9.6.

9.2.2.2 Reaeration/Streambank Stabilization

The purpose of reaeration is to increase DO concentrations in streams. Physical measures that will assist in increasing reaeration of a stream include bank stabilization, channel modifications, and the addition of riprap or pool and riffle sequences. Bank stabilization reduces erosion by planting vegetation along the bank or modification of the channel to decrease the slope of the bank. Riprap or pool and riffle sequences would increase reaeration by increasing turbulence. Turbulence creates an increase in the interaction between air and water, which draws air into the river increasing aeration. Expanding monitoring to several locations along the impaired segments could help identify reaches that would benefit the most from an increase of turbulence.

9.3 Implementation Actions and Management Measures for Manganese in Canteen Creek

Only two violations of the manganese standard have been recorded on Canteen Creek in the last 10 years. The only known sources of manganese to the creek are natural sources including overland runoff, soil erosion, and groundwater.

9.3.1 Point Sources of Manganese

The Township of Caseyville and City of Collinsville MS4 permits list Canteen Creek as their receiving water. Illinois MS4 permits require that six minimum controls be implemented to reduce pollutants discharged. The minimum controls are:

- Public Education/Outreach
- Public Participation/Involvement
- Illicit Discharge Detection/Elimination
- Construction Site Runoff Control
- Post Construction Runoff Control
- Pollution Prevention/Good Housekeeping

These six controls should result in stormwater quality that does not affect the loads of manganese to the creek. Future monitoring of stormwater outfalls will help determine the efficiency of the six minimum stormwater controls and will help to gage the contributions of manganese from urban storm sewers. The permitting section of Illinois EPA has the authority to review stormwater permits.

9.3.2 Nonpoint Sources of Manganese

It is likely that the main contributors to elevated manganese in Canteen Creek are natural background levels. As such, nonpoint source controls that are designed to reduce erosion are expected to provide a secondary benefit of reducing manganese that may be attached to the soil.

Following are examples of potentially applicable erosion control measures:

- Filter Strips
- Sediment Control Basins
- Streambank Stabilization/Erosion Control

The remainder of this section discusses these management options.

9.3.2.1 Filter Strips

Filter strips were discussed in Section 9.2.2.1. The same technique for evaluating available land was applied to Canteen Creek. There are 500 acres of land within 144 feet of Canteen Creek; of this area, 79 acres are categorized as agricultural and could potentially be converted into filter strips (see Figure 9-1).

9.3.2.2 Sediment Control Basins

Sediment control basins are designed to trap sediments (and the pollutants bound to the sediment) prior to reaching a receiving water. Sediment control basins are typically earthen embankments that act similarly to a terrace. The basin traps water and sediment running off cropland upslope from the structure, and reduces gully erosion by controlling flow within the drainage area. The basin then releases water slowly, which also helps to decrease streambank erosion in the receiving water.

Sediment control basins are usually designed to drain an area of 30 acres or less and should be large enough to control runoff form a 10-year, 24-hour storm. Locations are determined based on slopes, tillage and crop management, and local NRCS can often provide information and advice for design and installation. Maintenance includes reseeding and fertilizing the basins in order to maintain vegetation and periodic checking, especially after large storms to determine the need for embankment repairs or excess sediment removal.

9.3.2.3 Streambank Stabilization/Erosion Control

Soil erosion is the process of moving soil particles or sediment by flowing water or wind. Eroding soil transports pollutants, such as manganese, that can potentially degrade water quality.

Following are three available approaches to stabilizing eroding banks that could, in turn, decrease nonpoint source manganese loads:

- Stone Toe Protection (STP)
- Rock Riffle Grade Control (RR)
- Floodplain Excavation

Stone Toe Protection uses nonerodible materials to protect the eroding banks. Meandering bends found in the Canteen Creek watershed could possibly be stabilized by placing the hard armor only on the toe of the bank. STP is most commonly implemented "using stone quarry stone that is sized to resist movement and is placed on the lower one third of the bank in a windrow fashion" (STREAMS 2005).

Naturally stable stream systems typically have an alternating riffle-pool sequence that helps to dissipate stream energy. Rock Riffle Grade Control places loose rock grade control structures at locations where natural riffles would occur to create and enhance the riffle-pool flow sequence of stable streams. By installing RR in an incised channel, the riffles will raise the water surface elevation resulting in lower effective bank heights, which increases the bank stability by reducing the tractive force on the banks (STREAMS 2005).

Rather than raising the water level, Floodplain Excavation lowers the floodplain to create a more stable stream. Floodplain Excavation uses mechanical means to restore the floodplain by excavating and utilizing the soil that would eventually be eroded away and deposited in the lake (STREAMS 2005).

The extent of streambank erosion in the Canteen Creek watershed is unknown. It is recommended that further investigation be performed to determine the extent that erosion control measures could help manage nonpoint source manganese loads to the creek.

9.4 Implementation Actions and Management Measures for Fecal Coliform in Harding Ditch

The TMDL analysis performed for fecal coliform in Harding Ditch showed that the majority of the samples collected have exceeded the standard and that all samples collected during higher flow conditions have exceeded the standard. This indicates that potential sources are likely stormwater runoff and resuspension of instream fecal material.

9.4.1 Point Sources of Fecal Coliform

9.4.1.1 Stormwater Sources

A large portion of the Harding Ditch watershed is urban in nature. Within the ditch's watershed, the following municipalities have stormwater permits:

- East St. Louis
- Fairview Heights
- Caseyville
- Centreville
- Alortan
- Cahokia
- Belleville

Illinois MS4 permits require that six minimum controls be implemented to reduce pollutants discharged. The minimum controls are:

- Public Education/Outreach
- Public Participation/Involvement
- Illicit Discharge Detection/Elimination
- Construction Site Runoff Control
- Post Construction Runoff Control
- Pollution Prevention/Good Housekeeping

These six controls should result in stormwater quality that does not affect the loads of fecal coliform to the canal. Again, it is recommended that a storm sewer survey be performed to determine the amount of fecal coliform being contributed to the ditch via urban stormwater sources. The permitting section of Illinois EPA has the ability to review stormwater permits.

9.4.1.2 Municipal Wastewater Sources

There is one municipal treatment plant point source of fecal coliform to Harding Ditch. According to DMR records, the Caseyville Township West STP discharges 0.786 mgd with an average fecal coliform concentration of 138.0 cfu/100mL. The facility is located on Clare Creek and is significantly upstream of Harding Ditch. The treatment plant is assumed to have an insignificant impact to Harding Ditch due to the facility's location and low concentration discharge. Illinois EPA will examine this permit and will require the Caseyville Township West STP to demonstrate that their effluent will not impair water quality. The current Caseyville STP permit expires January 31, 2012.

9.4.2 Nonpoint Sources of Fecal Coliform

Several management options have been identified to help reduce fecal coliform counts in Harding Ditch. These management options focus on potential sources of fecal coliform within the basin, such as agricultural runoff, septic systems, and livestock. The alternatives that were identified are:

- Filter Strips
- Private Septic System Inspection and Maintenance Program
- Restrict Livestock Access to Harding Ditch and Tributaries

Each alternative is discussed briefly in this section.

9.4.2.1 Filter Strips

Filter strips were discussed in Section 9.2.2.1. The same technique for evaluating available land was applied to the Harding Ditch watershed. There are 775 acres of land within 144 feet of Harding Ditch, of this area, 146 acres are categorized as agricultural and could potentially be converted into filter strips (see Figure 9-1).

9.4.2.2 Private Septic System Inspection and Maintenance Program

The Stage 1 report identified 4,000 septic systems in Fairview Heights, which is located within Harding Ditch's contributing area and 700 septic systems within St. Clair County, in which Harding Ditch is situated. A program that actively manages functioning systems and addresses non-functioning systems could be put in place. The USEPA has developed guidance for managing septic systems, which includes assessing the functionality of systems, public health, and environmental risks (EPA 2005). It also introduces procedures for selecting and implementing a management plan.

To reduce the excessive amounts of contaminants from a faulty septic system, a regular maintenance plan that includes regular pumping and maintenance of the septic system should be followed. The majority of failures originate from excessive suspended solids, nutrients, and BOD loading to the septic system. Reduction of solids to the tank can be achieved via limiting garbage disposals use and water conservation.

Septic system management activities can extend the life and maintain the efficiency of a septic system. Water conservation practices, such as limiting daily water use or using low flow toilets and faucets, are the most effective methods to maintain a properly functioning septic system. Additionally, the system should not be used for the disposal of solids, such as cigarette butts, cat litter, cotton swabs, coffee grinds, disposable diapers, etc. Finally, physical damage to the drainfield can be prevented by:

- Maintaining a vegetative cover over the drainfield to prevent erosion
- Avoiding construction over the system
- Protecting the area down slope of the system from excavation
- Landscape the area to divert surface flow away from the drainfield (Johnson 1998)

The cost of each management measure is site specific and there is not specific data on septic systems and management practices for the watershed; therefore, costs for these practices were not outlined in Section 9.6.

Alternatively, a long-range solution to failing septic systems is a connection to a municipal sanitary sewer system. Installation of a sanitary sewer will reduce existing fecal coliform sources by replacing failing septic systems and will allow communities to develop without further contribution of fecal material to Harding Ditch. Costs for the installation are generally paid over a period of several years (average of 20 years) instead of forcing homeowners to shoulder the entire cost of installing a new septic system. In addition, costs are sometimes shared between the community and the utility responsible for treating the wastewater generated from replacing the septic tanks. The planning process is involved and requires participation from townships, cities, counties, and citizens.

9.4.2.3 Restrict Livestock Access to Harding Ditch and Tributaries

Livestock are present in St. Clair County, which encompasses the Harding Ditch subwatershed, including nearly 7,000 head of cattle and over 30,000 hogs and pigs (NASS 2004). It is unknown to what extent these animals have access to Harding Ditch or its tributaries. Reduction of livestock access to streams, however, is recommended to reduce bacteria loads. The USEPA found that livestock exclusion from waterways and other grazing management measures were successful in reducing fecal coliform counts by 29 to 46 percent (2003). Fencing and alternate watering systems are effective ways to restrict livestock from streams.

9.5 Implementation Actions and Management Measures for Phosphorus in the Frank Holten Lakes

Phosphorus loads in the Frank Holten Lakes watersheds originate from both external and internal sources. As discussed in previous sections, possible sources of total phosphorus to the Frank Holten Lakes include urban and parkland runoff and septic systems. To achieve a reduction of total phosphorus for these lakes, management measures must address loading through sediment and surface runoff controls and internal nutrient cycling through in-lake management.

9.5.1 Point Sources of Phosphorus

The phosphorus TMDLs for the Frank Holten Lakes describe waste load allocations for point source dischargers in the watershed. The Frank Holten Lakes do not have any point source contributions and the associated WLA was therefore set to zero.

9.5.1.1 Stormwater Sources

No MS4 permits list waters within the lake watersheds as receiving waters. However, the 303(d) list identified urban runoff as potential pollutant sources of total phosphorus for the Frank Holten Lakes. Figure 7-7 shows that the majority of the land within the Frank Holten Lakes watershed is developed. Runoff from low-density residential areas and a high school discharges into Lake 1 via three drainage district culverts. In addition, Harding Ditch contributes flows to Lake 3 during wet weather events. The urban stormwater sources contributing to the Cahokia Canal were discussed in Section 9.2.1.1. Stormwater sources within the Harding Ditch watershed were discussed in Section 9.4.1.1.

9.5.2 Nonpoint Sources of Phosphorus

Potential sources of nonpoint source phosphorus pollution to the Frank Holten Lakes include septic systems, urban runoff, and other recreational pollution sources. Other recreational pollution sources in the Frank Holten Lakes watershed include managed parkland and a golf course adjacent to Lakes 1 and 2.

BMPs available that could be utilized to treat these nonpoint sources in one or both watersheds are:

- Conservation tillage practices
- Filter strips
- Wetlands
- Nutrient management
- Septic system maintenance or sanitary system

Total phosphorus originating from cropland is most efficiently treated with a combination of no-till or conservation tillage practices and grass filter strips. A combination of filter strips and possibly wetlands could reduce phosphorus loads from the golf course at Frank Holten State Park. Nutrient management focuses on source control of nonpoint source contributions to both lakes.

9.5.2.1 Conservation Tillage Practices

For the Cahokia Canal watershed, conservation tillage practices could help reduce nutrient loads in the lakes. The lakes potentially receive nonpoint source runoff from the approximately 28 percent of the watershed, which is under cultivation. Total phosphorus loading from cropland is controlled through management BMPs, such as conservation tillage. Conservation tillage maintains at least 30 percent of the soil surface covered by residue after planting. Crop residuals or living vegetation cover on the soil surface protect against soil detachment from water and wind erosion. Conservation tillage practices can remove up to 45 percent of the dissolved and total phosphorus from runoff and approximately 75 percent of the sediment. Additionally, studies have found around 93 percent less erosion occurred from no-till acreage compared to acreage subject to moldboard plowing (USEPA 2003). The 2004 Illinois Department of Agriculture's Soil Transect Survey estimated that conventional till currently accounts for 68 percent of corn, 8 percent of soybean, and 6 percent of small grain tillage practices in Madison County; 96 percent of corn and 27 percent of soybeans in St. Clair County; and 60 percent of corn, 10 percent of soybeans, and 6 percent of small grains in Monroe County. To achieve TMDL load allocations, tillage practices already in place should be continued, and practices should be assessed and improved upon for all 73,373 agricultural acres in the Cahokia Canal watershed.

9.5.2.2 Filter Strips

Filter strips were discussed in Section 9.2.2.1. The same technique for evaluating available land was applied to the both lake watersheds. In the Frank Holten Lakes watershed, there are seven-and-one-half acres of land between the golf course and Lakes 1 and 2 that could potentially be converted to filter strips. In addition, the filter strips suggested for implementation within the Canteen Creek, Cahokia Canal and Harding Ditch watersheds would provide additional benefits in potentially reducing lake nutrient levels because stream flows from these larger watersheds reach the lakes during wet weather (see Figure 9-1).

9.5.2.3 Wetlands

The use of wetlands as a structural control is applicable to nutrient reduction from recreational land in the Frank Holten Lakes watershed. To treat loads generated at the Frank Holten State Park, a wetland could be constructed between the golf course and the lakes. Wetlands are an effective BMP for sediment and phosphorus control because they:

- Prevent floods by temporarily storing water, allowing the water to evaporate or percolate into the ground
- Improve water quality through natural pollution control such as plant nutrient uptake
- Filter sediment
- Slow overland flow of water thereby reducing soil erosion (USDA 1996)

A properly designed and functioning wetland can provide very efficient treatment of pollutants, such as phosphorus. Design of wetland systems is very important and should consider soils in the proposed location, hydraulic retention time, and space requirements. Constructed wetlands, which comprise the second or third stage of nonpoint source treatment, can be effective at improving water quality. Studies have shown that artificial wetlands designed and constructed specifically to remove pollutants from surface water runoff have removal rates for suspended solids of greater than 90 percent, 0 to 90 percent for total phosphorus, 20 to 80 percent of orthophosphate, and 10 to75 percent for nitrogen species (Johnson, Evans, and Bass 1996; Moore 1993; USEPA 1993; Kovosic et al. 2000). Although the removal rate for phosphorus is low in long-term studies, the rate can be improved if sheet flow is maintained to the wetland and vegetation and substrate are monitored to ensure the wetland is operation optimally. Sediment or vegetation removal may be necessary if the wetland removal efficiency is lessened over time (USEPA 1993; NCSU 2000).

Guidelines for wetland design suggest a wetland to watershed ratio of 0.6 percent for nutrient and sediment removal from agricultural runoff.

9.5.2.4 Nutrient Management

Nutrient management techniques could be applied to management practice currently employed at the Frank Holten State Park. Over-application of fertilizer to park lands and the golf course may be contributing to the nutrient problem and should be reviewed by park management.

9.5.2.5 Septic System Maintenance and Sanitary System

Septic systems in the Harding Ditch watershed are a potential source of nutrients to the Frank Holten Lakes. Septic system maintenance in the Harding Ditch watershed was discussed in Section 9.4.1.2.

9.5.3 In-Lake Phosphorus

Reduction of phosphorus from in-lake cycling through management strategies is also suggested for attainment of the TMDL allocation. Internal phosphorus loading occurs when the water above the sediments become anoxic causing the release of phosphorus from the sediment in a form that is available for plant uptake. The addition of bioavailable phosphorus in the water column stimulates more plant growth and die-off, which perpetuates the anoxic conditions and enhances the subsequent release of phosphorus into the water.

Control of internal phosphorus cycling must limit the release of phosphorus from the sediments either through lake oxygen concentration or sediment management. Aeration, which simulates lake mixing and keeps oxygen conditions from being depleted in the epilimnion, can be very effective at preventing re-release of bound phosphorus. Reduction of internal phosphorus cycling from this measure is typically determined based on site-specific studies. It is recommended that sampling be performed before and after and scenario changes to determine the effect of these management practices (i.e. canal diversion, impoundment pump-out, etc…).

Phosphorus release from the sediment is greatest from recently deposited layers. Dredging about one meter of recently deposited phosphorus–rich sediment can remove approximately 80 to 90 percent of the internally loaded phosphorus without the addition of potentially toxic compounds to the reservoir. Dredging is more costly than other management options (NRCS 1992). It should be noted that the Frank Holten Lakes were dredged in the early 1980s.

9.6 Reasonable Assurance

Reasonable assurance means that a demonstration is given that nonpoint source reductions in this watershed will be implemented. It should be noted that all programs discussed in this section are voluntary and some may currently be in practice in the watershed. The discussion in Sections 9.2 through 9.5 provided information on available BMPs for reducing phosphorus loads from point and nonpoint sources. The remainder of this section discusses an estimate of costs to the watershed for implementing nonpoint source management practices and programs available to assist with funding.

9.6.1 Available Programs for Nonpoint Source Management

There are several voluntary conservation programs established through the 2002 U.S. Farm Bill, which encourage landowners to implement resource-conserving practices for water quality and erosion control purposes. These programs would apply to crop fields and rural grasslands that are presently used as pasture land. Each program is discussed separately in the following paragraphs. It should be noted that the USDA has recently released proposals for the upcoming 2007 Farm Bill.

9.6.1.1 Illinois Department of Agriculture and Illinois EPA Nutrient Management Plan Project

The IDA and Illinois EPA are presently co-sponsoring a cropland Nutrient Management Plan project in watersheds that have or are developing a TMDL. This voluntary project supplies incentive payments to producers to have Nutrient Management Plans developed and implemented. Additionally, watersheds that have sediments or phosphorus identified as a cause for impairment (as is the case in this watershed), are eligible for cost-share assistance in implementing traditional erosion control practices through the Nutrient Management Plan project.

9.6.1.2 Conservation Reserve Program (CRP)

This voluntary program encourages landowners to plant long-term resource-conserving cover to improve soils, water, and wildlife resources. CRP is the USDA's single largest environmental improvement program and one of its most productive and cost-efficient. It is administered through the Farm Service Agency (FSA) by USDA's Commodity Credit Corporation (CCC). The program was initially established in the Food & Security Act of 1985. The duration of the contracts under CRP range from 10 to 15 years.

Eligible land must be one of the following:

1. Cropland that is planted or considered planted to an agricultural commodity two of the five most recent crop years (including field margins) and must be physically and legally capable of being planted in a normal manner to an agricultural commodity.

2. Certain marginal pastureland enrolled in the Water Bank Program.

The CCC bases rental rates on the relative productivity of soils within each county and the average of the past three years of local dry land cash rent or cash-rent equivalent. The maximum rental rate is calculated in advance of enrollment. Producers may offer land at the maximum rate or at a lower rental rate to increase likelihood of offer acceptance. In addition, the CCC provides cost-share assistance for up to 50 percent of the participant's costs in establishing approved conservation practices (USDA 2006).

Finally, CCC offers additional financial incentives of up to 20 percent of the annual payment for certain continuous sign-up practices (USDA 2006). Continuous sign-up provides management flexibility to farmers and ranchers to implement certain high-priority conservation practices on eligible land. The land must be determined by NRCS to be eligible and suitable for any of the following practices:

- Riparian buffers
- Filter strips
- Grass waterways
- Shelter belts
- Field windbreaks
- Living snow fences
- Contour grass strips
- Salt tolerant vegetation
- Shallow water areas for wildlife
- Eligible acreage within an EPA-designated wellhead protection area (FSA 1997)

The current extent of land enrolled in CRP within the Cahokia Canal watershed is unknown.

9.6.1.3 Clean Water Act Section 319 Grants

Section 319 was added to the CWA to establish a national program to address nonpoint sources of water pollution. Through this program, each state is allocated Section 319 funds on an annual basis according to a national allocation formula based on the total annual appropriation for the Section 319 grant program. The total award consists of two categories of funding: incremental funds and base funds. A state is eligible to receive EPA 319(b) grants upon USEPA's approval of the state's Nonpoint Source Assessment Report and Nonpoint Source Management Program. States may reallocate funds through subawards (e.g., contracts, subgrants) to both public and private entities, including local governments, tribal authorities, cities, counties, regional development centers, local school systems, colleges and universities, local nonprofit organizations, state agencies, federal agencies, watershed groups, for-profit groups, and individuals.

USEPA designates incremental funds, a $100-million award, for the restoration of impaired water through the development and implementation of watershed-based plans and TMDLs for impaired waters. Base funds, funds other than incremental funds, are used to provide staffing and support to manage and implement the state Nonpoint Source Management Program. Section 319 funding can be used to implement activities that improve water quality, such as filter strips, streambank stabilization, etc. (USEPA 2003).

9.6.1.4 Wetlands Reserve Program (WRP)

The Wetlands Reserve Program (WRP) is a voluntary program that provides technical and financial assistance to eligible landowners to restore, enhance, and protect wetlands. The goal of WRP is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program. At least 70 percent of each project area will be restored to the original natural condition, to the extent practicable. The remaining 30 percent of each area may be restored to other than natural conditions. Landowners have the option of enrolling eligible lands through permanent easements, 30-year easements, or 10-year restoration cost-share agreements. The program is offered on a continuous sign-up basis and is available nationwide. WRP offers landowners an opportunity to establish, at minimal cost, long-term conservation and wildlife habitat enhancement practices and protection. It is administered through the NRCS (2002b).

Eligible participants must have owned the land for at least one year and be able to provide clear title. Restoration agreement participants must show evidence of ownership. Owners may be an individual, partnership, association, corporation, estate, trust, business, or other legal entity; a state (when applicable); a political subdivision of a state; or any agency thereof owning private land. Land eligibility is dependent on length of ownership, whether the site has been degraded as a result of agriculture, and the land's ability to be restored.

The 2002 Farm Bill reauthorized the program through 2007. The reauthorization increased the acreage enrollment cap to 2,275,000 acres with an annual enrollment of 250,000 acres per calendar year. The program is limited by the acreage cap and not by program funding. Since the program began in 1985, the average cost per acre is $1,400 in restorative costs and the average project size is 177 acres. The costs for each enrollment options follow in Table 9-5 (USDA 2006).

Table 9-5 Costs for Enrollment Options of WRP Program

Option	Permanent Easement	30-year Easement	Restoration Agreement
Payment for Easement	100% Agricultural Value	75% Agricultural Value	NA
Payment Options	Lump Sum	Lump Sum	NA
Restoration Payments	100% Restoration Cost Reimbursements	75% Restoration Cost Reimbursements	75% Restoration Cost Reimbursements

9.6.1.5 Environmental Quality Incentive Program (EQIP)

The Environmental Quality Incentive Program (EQIP) is a voluntary USDA conservation program for farmers and private landowners engaged in livestock or agricultural production who are faced with serious threats to soil, water, and related natural resources. It provides technical, financial, and educational assistance primarily in designated "priority areas." National priorities include the reduction of non-point source pollution, such as nutrients, sediment, pesticides, or excess salinity in impaired watersheds, consistent with TMDLs where available, and the reduction in soil erosion and sedimentation from unacceptable levels on agricultural land. The program goal is to maximize environmental benefits per dollar expended and provides "(1) flexible technical and financial assistance to farmers and ranchers that face the most serious natural resource problems; (2) assistance to farmers and ranchers in complying with federal, state, and tribal environmental laws, and encourage environmental enhancement; (3) assistance to farmers and ranchers in making beneficial, cost-effective changes to measures needed to conserve and improve natural resources; and (4) for the consolidation and simplification of the conservation planning process (NRCS 2002)."

Landowners, with the assistance of a local NRCS or other service provider, are responsible for the development of an EQIP plan that includes a specific conservation and environmental objective, one or more conservation practices in the conservation management system to be implemented to achieve the conservation and environmental objectives, and the schedule for implementing the conservation practices. This plan becomes the basis of the cost-share agreement between NRCS and the participant. NRCS provides cost-share payments to landowners under these agreements that can be up to 10 years in duration.

Cost-share assistance may pay landowners up to 75 percent of the costs of conservation practices, such as grassed waterways, filter strips, manure management, capping abandoned wells, and other practices important to improving and maintaining the health of natural resources in the area. EQIP cost-share rates for limited resource producers and beginning farmers may be up to 90 percent. Total incentive and cost-share payments are limited to an aggregate of $450,000 (NRCS 2006).

9.6.1.6 Wildlife Habitat Incentives Program (WHIP)

The Wildlife Habitat Incentives Program (WHIP) is a voluntary program that encourages the creation of high quality wildlife habitat of national, state, tribal, or local significance. WHIP is administered through NRCS, which provides technical and financial assistance to landowners for development of upland, riparian, and aquatic habitat areas on their property. NRCS works with the participant to develop a wildlife habitat development plan, which becomes the basis of the cost-share agreement between NRCS and the participant. Most contracts are five to 10 years in duration, depending upon the practices to be installed. However, longer term contracts of 15 years or greater may also funded. In addition, if the landowner agrees, cooperating state wildlife agencies and nonprofit or private organizations may provide expertise or additional funding to help complete a project.

9.6.1.7 Streambank Stabilization and Restoration Practice

The Streambank Stabilization and Restoration Practice (SSRP) was established to address problems associated with streambank erosion, such as loss or damage to valuable farmland, wildlife habitat, and roads; stream capacity reduction through sediment deposition; and degraded water quality, fish, and wildlife habitat. The primary goals of the SSRP are to develop and demonstrate vegetative, stone structure, and other low cost bio-engineering techniques for stabilizing streambanks and to encourage the adoption of low-cost streambank stabilization practices by making available financial incentives, technical assistance, and educational information to landowners with critically eroding streambanks. A cost share of 75 percent is available for approved project components such as willow post installation, bendway weirs, rock riffles, stream barbs/rock, vanes, lunker structures, gabion baskets, and stone toe protection techniques. There is no limit on the total program payment for cost-share projects that a landowner can receive in a fiscal year. However, maximum cost per foot of bank treated is used to cap the payment assistance on a per foot basis and maintain the program's objectives of funding low-cost techniques (IDA 2000).

9.6.1.8 Conservation Practices Cost-Share Program

The Conservation Practices Program (CPP) is a 10-year program. The practices consist of waterways, water and sediment control basins (WASCOBs), pasture/hayland establishment, critical area, terrace system, no-till system, diversions, and grade stabilization structures. The CPP is state-funded through the Department of Agriculture. There is a project cap of $5,000 per landowner and costs per acre vary significantly from project to project.

9.6.1.9 Local Program Information

The Farm Service Agency (FSA) administers the CRP. NRCS administers the EQIP, WRP, and WHIP. Local NRCS contact information in St. Clair and Madison County are listed in the Table 9-6 below.

Table 9-6 Local NRCS and FSA Contact Information

Contact	Address	Phone
Local NRCS Office		
Madison County	7205 Marine Road Edwardsville, IL 62025	618.656.4710 ext. 3
St. Clair County	2031 Mascoutah Avenue Belleville, IL 62220	618.235.2500 ext. 3

9.6.2 Cost Estimates of BMPs

Cost estimates for different BMPs and individual practice prices such as filter strip installation are detailed in the following sections. Finally, an estimate of the total order of magnitude costs for implementation measures in the Cahokia Canal watershed are presented in Section 9.6.2.7 and Table 9-7.

9.6.2.1 Wetlands

The price to establish a wetland is very site specific. There are many different costs that could be incurred depending on wetland construction. Examples of costs associated with constructed wetlands include excavation costs. NRCS estimates excavation cost at $2/cubic foot. Establishment of vegetation in critical areas including seeding and fertilizing is estimated at $230/acre. It should be noted that the larger the wetland acreage to be established, the more cost-effective the project.

9.6.2.2 Filter Strips and Riparian Buffers

In previous studies, the NRCS has estimated an average cost per acre to install and maintain a grass filter strip with a five-year life span at $54/acre for nonnative species and $188/acre for native species. This price quote accounts for seeding and mowing every other year to remove woody sprouts. A riparian buffer strip established with bare root stock has a life span of 10-years and an installation cost of $350/acre.

9.6.2.3 Nutrient Management Plan – NRCS

A portion of the rural land in the Cahokia Canal watershed is comprised of cropland. The service for developing a nutrient management plan averages $5 to $15/acre.

9.6.2.4 Nutrient Management Plan – IDA and Illinois EPA

The costs associated with development of Nutrient Management Plans co-sponsored by the IDA and the Illinois EPA is estimated as $10/acre paid to the producer and $3/acre for a third party vendor who develops the plans. There is a 200 acre cap per producer. The total plan development cost is estimated at $13/acre.

9.6.2.5 Conservation Tillage

Conservation tillage is assumed to include tillage practices that preserve at least 30 percent residue cover of the soil after crops are planted. Costs associated with converting to conservation tillage will depend on the degree of conservation tillage practices implemented. The University of Iowa has estimated a cost for conversion to no-till practices. The study acknowledged that some equipment conversion is needed, but converting to no-till only means (for most producers) the addition of heavier down-pressure springs, row cleaners, and possibly a coulter on each planter row unit. The cost of converting existing equipment ranges between $300 and $400 per planter row, which for many producers, amounts to a nominal additional production cost of approximately $1 or $2 per acre per year (Al-Kaisi 2002).

9.6.2.6 Internal Cycling

Controls of internal phosphorus cycling in lakes are costly. As discussed above, an aeration system is very site-specific; therefore, cost is not discussed here. However, dredging is typically the most expensive management practice averaging $8,000/acre. Although cost is high, the practice is 80 to 90 percent effective at nutrient removal and will last for at least 50 years (Cortell 2002; Geney 2002). The Frank Holten Lakes were dredged in the early 1980s.

9.6.2.7 Planning Level Cost Estimates for Implementation Measures

Cost estimates for different implementation measures are presented in Table 9-7. The column labeled "Program" or "Sponsor" lists the financial assistance program or sponsor available for various BMPs. The programs and sponsors represented in the table are the Wetlands Reserve Program (WRP), the Conservation Reserve Program (CRP), National Resource Conservation Service (NRCS), Conservation Cost-Share

Program (CPP), Illinois EPA, and Illinois Department of Agriculture (IDA). It should be noted that IEPA 319 Grants are applicable to all of these practices.

Table 9-7 Cost Estimate of Various BMP Measures in McLean County

Source	Program	Sponsor	BMP	Installation Mean $/acre
Nonpoint	CRP/CPP	NRCS and IDA	Grass filter strip -native	$188
	CRP/CPP	NRCS and IDA	Grass filter strip -nonnative	$54
	WRP	NRCS	Wetland	varies
		NRCS	Nutrient Management Plan	$10
		IDA and Illinois EPA	Nutrient Management Plan	$13
	CRP/CPP	NRCS and IDA	Conservation Tillage	varies
Internal Cycling			Dredging	$8,000

Total watershed costs will depend on the combination of BMPs selected to target non-point sources within the watershed. Regular monitoring will support adaptive management of implementation activities to most efficiently reach the TMDL goals.

9.7 Monitoring Plan

The purpose of the monitoring plan for the Cahokia Canal watershed is to assess the overall implementation of management actions outlined in this section. This can be accomplished by conducting the following monitoring programs:

- Track implementation of management measures in the watershed
- Estimate effectiveness of management measures
- Monitoring of point source discharges in the watershed
- Continued ambient monitoring of all TMDL segments
- Investigation of tile line flow and associated water quality from agricultural land
- Further information gathering on area septic systems including locations and failure rates
- Storm-based monitoring of high flow events
- Tributary monitoring
- Storm Sewer surveys to monitor outfall concentration of parameters of concern

Tracking the implementation of management measures can be used to address the following goals:

- Determine the extent to which management measures and practices have been implemented compared to action needed to meet TMDL endpoints
- Establish a baseline from which decisions can be made regarding the need for additional incentives for implementation efforts
- Measure the extent of voluntary implementation efforts

- Further clarify the contributions from point sources
- Support work-load and costing analysis for assistance or regulatory programs
- Determine the extent to which management measures are properly maintained and operated

Estimating the effectiveness of the BMPs implemented in the watershed could be completed by monitoring before and after the BMP is incorporated into the watershed. Additional monitoring could be conducted on specific structural systems such as a constructed wetland. Inflow and outflow measurements could be conducted to determine site-specific removal efficiency. If aeration is used to control internal loading, site-specific data could be collected to assess the effectiveness of this management measure.

IEPA monitors lakes every three years and conducts Intensive Basin Surveys every five years. Additionally, ambient sites are monitored nine times a year. Continuation of this state monitoring program will assess lake and stream water quality as improvements in the watershed are completed. This data will also be used to assess whether water quality standards in the impaired segments are being attained.

Regular and more extensive monitoring of point sources in the watershed would confirm their collective contributions and add confidence to the modeled conclusion that low flows and not point sources are the driving factor behind low DO levels in the canal. As permits come up for renewal, Illinois EPA NPDES program should review the permits and decide if further management measures are required.

Stormwater outfall monitoring will also confirm stormwater contributions throughout the watershed. Urban stormwater is a potential pollutant source for each impaired waterbody segment in the watershed. Outfall monitoring for parameters of concern is suggested.

Continued tributary monitoring is needed to further assess the contribution of internal loading to the impaired watershed lakes. By having more knowledge on actual contributions from external loads a more precise estimate of internal loads could occur. Data on the different forms of phosphorus (dissolved, total, or orthophosphate) would also be beneficial to better assess reservoir responses to phosphorus loading.

9.8 Implementation Time Line

Implementing the actions outlined in this section for the Cahokia Canal watershed should occur in phases and assessing effectiveness of the management actions as improvements are made. It is assumed that it may take up to five years to secure funding for actions needed in the watershed and five to seven years after funding to implement the measures. Once improvements are implemented, it may take impaired segments 10 years or more to reach their water quality standard targets. In summary, it may take up to 20 years for impaired segments to meet the applicable water quality standards.

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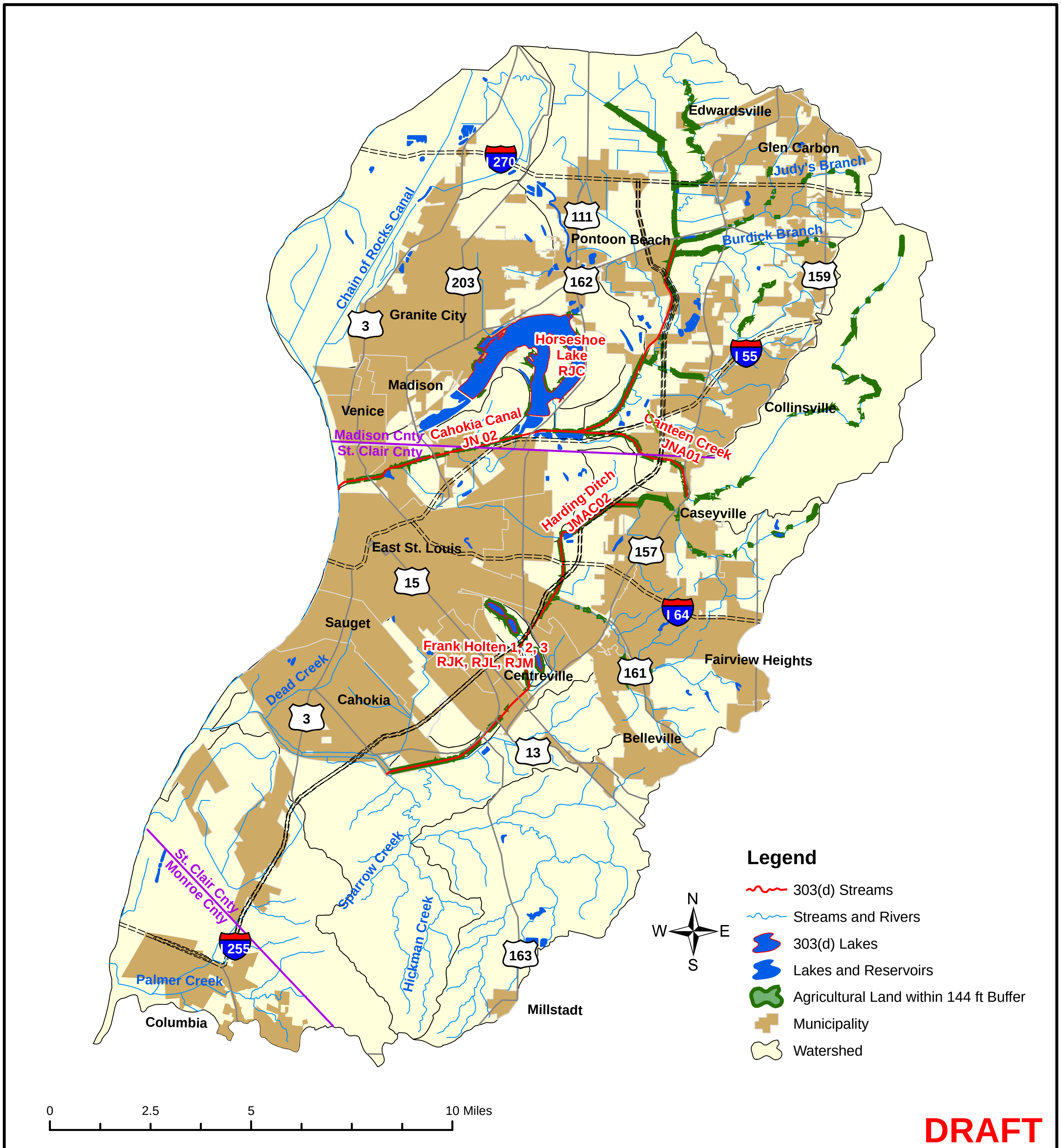

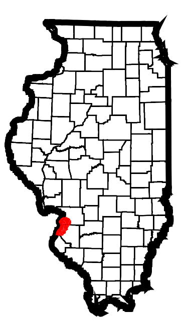

Figure 9-1
Cahokia Canal/Horseshoe Lake Watershed
Potential Areas for Filter Strips

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Section 10
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Appendix A
Land Use Categories

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File names and descriptions:

Values and class names found in the Land Cover of Illinois 1999-2000 Arc/Info GRID coverage.

Value	Class Names
0	Background
	AGRICULTURAL LAND
11	Corn
12	Soybeans
13	Winter Wheat
14	Other Small Grains & Hay
15	Winter Wheat/Soybeans
16	Other Agriculture
17	Rural Grassland
	FORESTED LAND
21	Upland
25	Partial Canopy/Savannah Upland
26	Coniferous
	URBAN & BUILT-UP LAND
31	High Density
32	Low/Medium Density
35	Urban Open Space
	WETLAND
41	Shallow Marsh/Wet Meadow
42	Deep Marsh
43	Seasonally/Temporally Flooded
44	Floodplain Forest
48	Swamp
49	Shallow Water
	OTHER
51	Surface Water
52	Barren & Exposed Land
53	Clouds
54	Cloud Shadows

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Appendix B
Soil Characteristics

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Appendix B Cahokia Canal/Horseshoe Lake Watershed Soil Series Characteristics						
SSURGO Soil Series Code	SSURGO Soil Series Code Definition	Acres	Percent of Watershed	Dominant Hydrologic Soil Group	Minimum K-factor	Maximum K-factor
123	Riverwash	21.05	0.01%	NA	NA	NA
533	URBAN LAND	12564.23	6.92%	NA	0.24	0.43
536	DUMPS	646.34	0.36%	NA	0.32	0.32
864	PITS, QUARRIES	582.13	0.32%	NA	0.15	0.43
865	Pits, gravel	83.61	0.05%	NA	NA	NA
866	DUMPS, SLURRY	13.18	0.01%	NA	NA	NA
1070L	Oil waste land	1924.84	1.06%	D	0.28	0.32
1071A	DARWIN SILTY CLAY LOAM, UNDRAINED, 0 TO 2 PERCENT SLOPES, FREQUENTLY FLOODED	1650.68	0.91%	D	0.24	0.28
113A	Oconee silt loam, 0 to 2 percent slopes	2.81	0.00%	C	0.32	0.49
113B	Oconee silt loam, 2 to 5 percent slopes	18.54	0.01%	C	0.32	0.49
1248A	MCFAIN SILTY CLAY LOAM, UNDRAINED, 0 TO 2 PERCENT SLOPES, FREQUENTLY FLOODED	823.56	0.45%	C	0.24	0.32
1591A	Fults silty clay, undrained, 0 to 2 percent slopes, occasionally flooded	94.66	0.05%	D	0.24	0.32
165A	Weir silt loam, 0 to 2 percent slopes	2.89	0.00%	D	0.37	0.55
2071L	DARWIN-URBAN LAND COMPLEX, 0 TO 2 PERCENT SLOPES, OCCASIONALLY FLOODED, LONG DURATION	2992.84	1.65%	NA	0.24	0.28
2079D	MENFRO-URBAN LAND COMPLEX, 8 TO 15 PERCENT SLOPES	327.68	0.18%	NA	0.37	0.49
2079E	MENFRO-URBAN LAND COMPLEX, 15 TO 25 PERCENT SLOPES	99.99	0.06%	NA	0.37	0.49
216G	Stookey silt loam, 35 to 70 percent slopes	9.03	0.00%	B	0.43	0.55
2183A	SHAFFTON-URBAN LAND COMPLEX, 0 TO 2 PERCENT SLOPES, OCCASIONALLY FLOODED	8005.31	4.41%	NA	0.24	0.32
2284A	Tice-Fluvents-Urban land complex, 0 to 2 percent slopes, occasionally flooded	565.73	0.31%	NA	0.24	0.32
2304B	Landes-Fluvents-Urban land complex, 2 to 5 percent slopes, occasionally flooded	1332.74	0.73%	NA	0.2	0.32
2384B	EDWARDSVILLE-URBAN LAND COMPLEX, 1 TO 4 PERCENT SLOPES	447.86	0.25%	NA	0.28	0.49
2477B	WINFIELD-URBAN LAND COMPLEX, 2 TO 8 PERCENT SLOPES	2716.38	1.50%	NA	0.37	0.49

Appendix B Cahokia Canal/Horseshoe Lake Watershed Soil Series Characteristics (continued)						
SSURGO Soil Series Code	**SSURGO Soil Series Code Definition**	**Acres**	**Percent of Watershed**	**Dominant Hydrologic Soil Group**	**Minimum K-factor**	**Maximum K-factor**
2592A	Nameoki-Fluvents-Urban land complex, 0 to 2 percent slopes, occasionally flooded	1279.51	0.70%	D	0.24	0.32
267A	Caseyville silt loam, 0 to 2 percent slopes	466.41	0.26%	B	0.37	0.55
267B	Caseyville silt loam, 2 to 5 percent slopes	154.98	0.09%	B	0.37	0.49
283B	Downsouth silt loam, 2 to 5 percent slopes	277.99	0.15%	B	0.24	0.49
283C2	Downsouth silt loam, 5 to 10 percent slopes, eroded	28.23	0.02%	B	0.24	0.49
3038B	Rocher loam, 2 to 5 percent slopes, frequently flooded	1558.97	0.86%	B	0.24	0.32
3070L	Beaucoup silty clay loam, 0 to 2 percent slopes, frequently flooded, long duration	895.76	0.49%	B/D	0.28	0.32
3071L	Darwin silty clay, 0 to 2 percent slopes, frequently flooded, long duration	750.80	0.41%	D	0.24	0.28
3076A	OTTER SILT LOAM, 0 TO 2 PERCENT SLOPES, FREQUENTLY FLOODED	68.56	0.04%	B/D	0.32	0.49
3092B	Sarpy fine sand, 2 to 5 percent slopes, frequently flooded	21.81	0.01%	A	0.15	0.15
3180A	DUPO SILT LOAM, 0 TO 2 PERCENT SLOPES, FREQUENTLY FLOODED	51.96	0.03%	C	0.24	0.55
31A	Pierron silt loam, 0 to 2 percent slopes	38.45	0.02%	D	0.37	0.55
3333A	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded	4021.27	2.21%	C	0.28	0.55
3334L	Birds silt loam, 0 to 2 percent slopes, frequently flooded, long duration	266.90	0.15%	C/D	0.28	0.55
3336A	Wilbur silt loam, 0 to 2 percent slopes, frequently flooded	1177.73	0.65%	B	0.43	0.49
3391A	Blake silty clay loam, 0 to 2 percent slopes, frequently flooded	908.54	0.50%	B	0.24	0.55
3394A	HAYNIE SILT LOAM, 0 TO 2 PERCENT SLOPES, FREQUENTLY FLOODED	491.83	0.27%	B	0.24	0.37
3394B	Haynie silt loam, 2 to 5 percent slopes, frequently flooded	651.20	0.36%	B	0.24	0.37
3415A	Orion silt loam, 0 to 2 percent slopes, frequently flooded	385.25	0.21%	C	0.28	0.55
3592A	Nameoki silty clay loam, 0 to 2 percent slopes, frequently flooded	1836.45	1.01%	D	0.24	0.32
35F	Bold silt loam, 18 to 35 percent slopes	33.46	0.02%	B	0.43	0.55
3646A	Fluvaquents, loamy, 0 to 2 percent slopes, frequently flooded	171.21	0.09%	C	0.24	0.32

Appendix B Cahokia Canal/Horseshoe Lake Watershed Soil Series Characteristics (continued)						
SSURGO Soil Series Code	**SSURGO Soil Series Code Definition**	**Acres**	**Percent of Watershed**	**Dominant Hydrologic Soil Group**	**Minimum K-factor**	**Maximum K-factor**
37A	WORTHEN SILT LOAM, 0 TO 2 PERCENT SLOPES	455.11	0.25%	B	0.32	0.49
37B	WORTHEN SILT LOAM, 2 TO 5 PERCENT SLOPES	318.00	0.18%	B	0.32	0.49
3847L	Fluvaquents-Orthents complex, frequently flooded, long duration	1339.60	0.74%	C	0.24	0.32
384A	Edwardsville silt loam, 0 to 2 percent slopes	796.01	0.44%	B	0.24	0.49
384B	EDWARDSVILLE SILT LOAM, 2 TO 5 PERCENT SLOPES	169.36	0.09%	B	0.28	0.49
385A	Mascoutah silty clay loam, 0 to 2 percent slopes	287.89	0.16%	B	0.24	0.49
438B	Aviston silt loam, 2 to 5 percent slopes	8.75	0.00%	B	0.24	0.49
441B	Wakenda silt loam, 2 to 5 percent slopes	85.07	0.05%	B	0.28	0.49
441C2	Wakenda silt loam, 5 to 10 percent slopes, eroded	15.07	0.01%	B	0.28	0.49
466A	BARTELSO SILT LOAM, 0 TO 2 PERCENT SLOPES	46.70	0.03%	D	0.28	0.43
46A	Herrick silt loam, 0 to 2 percent slopes	52.83	0.03%	B	0.24	0.49
477B	Winfield silt loam, 2 to 5 percent slopes	4853.69	2.67%	B	0.37	0.49
477B2	WINFIELD SILT LOAM, 2 TO 5 PERCENT SLOPES, ERODED	4.54	0.00%	B	0.37	0.49
477B3	Winfield silty clay loam, 2 to 5 percent slopes, severely eroded	27.77	0.02%	B	0.37	0.49
477C2	Winfield silt loam, 5 to 10 percent slopes, eroded	383.32	0.21%	B	0.37	0.49
477C3	Winfield silty clay loam, 5 to 10 percent slopes, severely eroded	439.81	0.24%	B	0.37	0.49
477D3	Winfield silty clay loam, 10 to 18 percent slopes, severely eroded	482.65	0.27%	B	0.37	0.49
491B2	RUMA SILTY CLAY LOAM, 2 TO 5 PERCENT SLOPES, ERODED	36.69	0.02%	B	0.37	0.43
5079C	Menfro silt loam, karst, 5 to 12 percent slopes, severely eroded	768.06	0.42%	B	0.37	0.49
5079D	Menfro silt loam, karst, 12 to 25 percent slopes, severely eroded	2676.77	1.47%	B	0.37	0.49
5079G	Menfro silt loam, karst, 25 to 60 percent slopes	2465.32	1.36%	B	0.37	0.49
50A	Virden silt loam, 0 to 2 percent slopes	55.93	0.03%	B/D	0.24	0.49
515C2	BUNKUM SILT LOAM, 5 TO 10 PERCENT SLOPES, ERODED	29.27	0.02%	C	0.37	0.49
515C3	Bunkum silty clay loam, 5 to 10 percent slopes, severely eroded	683.39	0.38%	C	0.37	0.49
515D3	Bunkum silty clay loam, 10 to 18 percent slopes, severely eroded	1262.21	0.69%	C	0.37	0.49
517A	Marine silt loam, 0 to 2 percent slopes	445.92	0.25%	C	0.32	0.55
517B	Marine silt loam, 2 to 5 percent slopes	152.51	0.08%	C	0.32	0.55
582B	Homen silt loam, 2 to 5 percent slopes	811.00	0.45%	B	0.37	0.49

Appendix B Cahokia Canal/Horseshoe Lake Watershed Soil Series Characteristics (continued)						
SSURGO Soil Series Code	SSURGO Soil Series Code Definition	Acres	Percent of Watershed	Dominant Hydrologic Soil Group	Minimum K-factor	Maximum K-factor
582B2	Homen silt loam, 2 to 5 percent slopes, eroded	7.82	0.00%	B	0.37	0.43
582C2	Homen silt loam, 5 to 10 percent slopes, eroded	32.77	0.02%	B	0.37	0.43
630D3	Navlys silty clay loam, 10 to 18 percent slopes, severely eroded	388.26	0.21%	B	0.37	0.49
7037A	Worthen silt loam, 0 to 2 percent slopes, rarely flooded	1097.79	0.60%	B	0.28	0.49
7037B	Worthen silt loam, 2 to 5 percent slopes, rarely flooded	330.10	0.18%	B	0.32	0.49
7053B	Bloomfield loamy fine sand, 2 to 5 percent slopes, rarely flooded	549.50	0.30%	A	0.02	0.15
7075B	Drury silt loam, 2 to 5 percent slopes, rarely flooded	233.77	0.13%	B	0.32	0.49
7081A	Littleton silt loam, 0 to 2 percent slopes, rarely flooded	301.68	0.17%	B	0.28	0.49
7122B	Colp silt loam, 2 to 5 percent slopes, rarely flooded	20.37	0.01%	C	0.32	0.49
7122C	Colp silty clay loam, 5 to 10 percent slopes, severely eroded, rarely flooded	4.52	0.00%	C	0.32	0.37
7150A	Onarga sandy loam, 0 to 2 percent slopes, rarely flooded	336.57	0.19%	B	0.02	0.32
7151A	Ridgeville fine sandy loam, 0 to 2 percent slopes, rarely flooded	159.01	0.09%	B	0.02	0.28
7338A	Hurst silty clay loam, 0 to 2 percent slopes, rarely flooded	22.87	0.01%	D	0.28	0.49
7430A	Raddle silt loam, 0 to 2 percent slopes, rarely flooded	506.88	0.28%	B	0.32	0.49
7445A	Newhaven loam, 0 to 2 percent slopes, rarely flooded	59.16	0.03%	B	0.24	0.32
75B	Drury silt loam, 2 to 5 percent slopes	439.40	0.24%	B	0.43	0.49
75C	Drury silt loam, 5 to 10 percent slopes	17.76	0.01%	B	0.43	0.49
75D	Drury silt loam, 10 to 18 percent slopes	10.92	0.01%	B	0.43	0.49
75F	Drury silt loam, 18 to 35 percent slopes	69.98	0.04%	B	0.49	0.49
7741B	Oakville fine sand, 2 to 5 percent slopes, rarely flooded	188.92	0.10%	A	0.02	0.28
7741C	Oakville fine sand, 5 to 10 percent slopes, rarely flooded	64.93	0.04%	A	0.02	0.28
79B	Menfro silt loam, 2 to 5 percent slopes	7381.60	4.06%	B	0.37	0.55
79C2	Menfro silt loam, 5 to 10 percent slopes, eroded	2867.98	1.58%	B	0.37	0.49
79C3	Menfro silty clay loam, 5 to 10 percent slopes, severely eroded	598.51	0.33%	B	0.37	0.49
79D2	Menfro silt loam, 10 to 18 percent slopes, eroded	894.81	0.49%	B	0.37	0.49
79D3	Menfro silty clay loam, 10 to 18 percent slopes, severely eroded	2840.82	1.56%	B	0.37	0.49
79F	Menfro silt loam, 18 to 35 percent slopes	4212.20	2.32%	B	0.37	0.55

Appendix B Cahokia Canal/Horseshoe Lake Watershed Soil Series Characteristics (continued)						
SSURGO Soil Series Code	**SSURGO Soil Series Code Definition**	**Acres**	**Percent of Watershed**	**Dominant Hydrologic Soil Group**	**Minimum K-factor**	**Maximum K-factor**
79F3	Menfro silty clay loam, 18 to 35 percent slopes, severely eroded	2000.89	1.10%	B	0.37	0.49
79G	Menfro silt loam, 35 to 60 percent slopes	1630.02	0.90%	B	0.37	0.49
801B	Orthents, silty, undulating	239.48	0.13%	C	0.24	0.43
801D	Orthents, silty, steep	1442.80	0.79%	C	0.43	0.43
802B	Orthents, loamy, undulating	2042.12	1.12%	C	0.24	0.49
802D	Orthents, loamy, steep	2193.69	1.21%	B	0.32	0.43
8038B	Rocher loam, 2 to 5 percent slopes, occasionally flooded	494.56	0.27%	B	0.24	0.32
8070A	Beaucoup silty clay loam, 0 to 2 percent slopes, occasionally flooded	1575.10	0.87%	B	0.28	0.32
8071L	Darwin silty clay, 0 to 2 percent slopes, occasionally flooded, long duration	15611.95	8.60%	D	0.24	0.28
8078A	Arenzville silt loam, 0 to 2 percent slopes, occasionally flooded	224.00	0.12%	B	0.43	0.49
8084A	Okaw silt loam, 0 to 2 percent slopes, occasionally flooded	13.87	0.01%	D	0.32	0.49
8162A	GORHAM SILTY CLAY LOAM, 0 TO 2 PERCENT SLOPES, OCCASIONALLY FLOODED	709.85	0.39%	B	0.24	0.32
8180A	Dupo silt loam, 0 to 2 percent slopes, occasionally flooded	2901.12	1.60%	C	0.24	0.55
8183A	Shaffton clay loam, 0 to 2 percent slopes, occasionally flooded	6009.83	3.31%	B	0.24	0.32
81A	LITTLETON SILT LOAM, 0 TO 2 PERCENT SLOPES	352.81	0.19%	B	0.32	0.49
821G	MORRISTOWN VERY STONY SILTY CLAY LOAM, 35 TO 70 PERCENT SLOPES	273.74	0.15%	C	0.28	0.37
825B	LENZBURG SILTY CLAY LOAM, ACID SUBSTRATUM, 1 TO 7 PERCENT SLOPES	114.04	0.06%	B	0.32	0.37
826D	ORTHENTS, SILTY, ACID SUBSTRATUM, ROLLING	65.32	0.04%	C	0.43	0.43
8284A	Tice silty clay loam, 0 to 2 percent slopes, occasionally flooded	2730.42	1.50%	B	0.24	0.32
8302A	Ambraw silty clay loam, 0 to 2 percent slopes, occasionally flooded	836.87	0.46%	B/D	0.24	0.28
8304B	Landes very fine sandy loam, 2 to 5 percent slopes, occasionally flooded	6430.52	3.54%	B	0.2	0.32
8331A	Haymond silt loam, 0 to 2 percent slopes, occasionally flooded	648.53	0.36%	B	0.28	0.55
8333A	Wakeland silt loam, 0 to 2 percent slopes, occasionally flooded	600.61	0.33%	C	0.43	0.55

Appendix B Cahokia Canal/Horseshoe Lake Watershed Soil Series Characteristics (continued)						
SSURGO Soil Series Code	**SSURGO Soil Series Code Definition**	**Acres**	**Percent of Watershed**	**Dominant Hydrologic Soil Group**	**Minimum K-factor**	**Maximum K-factor**
8334A	Birds silt loam, 0 to 2 percent slopes, occasionally flooded	878.75	0.48%	C/D	0.43	0.49
8336A	Wilbur silt loam, 0 to 2 percent slopes, occasionally flooded	11.96	0.01%	B	0.37	0.55
8338B	Hurst silt loam, 2 to 5 percent slopes, occasionally flooded	25.43	0.01%	D	0.32	0.49
8338C	HURST SILTY CLAY LOAM, 5 TO 10 PERCENT SLOPES, ERODED, OCCASIONALLY FLOODED	8.81	0.00%	D	0.32	0.43
8394A	HAYNIE SILT LOAM, 0 TO 2 PERCENT SLOPES, OCCASIONALLY FLOODED	217.47	0.12%	B	0.24	0.37
8394B	Haynie silt loam, 2 to 5 percent slopes, occasionally flooded	255.05	0.14%	B	0.24	0.37
8415A	Orion silt loam, 0 to 2 percent slopes, occasionally flooded	168.34	0.09%	C	0.43	0.55
8434B	RIDGWAY SILT LOAM, 2 TO 5 PERCENT SLOPES, OCCASIONALLY FLOODED	7.93	0.00%	B	0.15	0.43
8457L	Booker clay, 0 to 2 percent slopes, occasionally flooded, long duration	230.37	0.13%	D	0.24	0.28
8591A	Fults silty clay, 0 to 2 percent slopes, occasionally flooded	5038.86	2.77%	D	0.24	0.32
8592A	Nameoki silty clay, 0 to 2 percent slopes, occasionally flooded	3772.00	2.08%	D	0.24	0.32
8646A	FLUVAQUENTS, LOAMY, 0 TO 2 PERCENT SLOPES, OCCASIONALLY FLOODED	1366.90	0.75%	C	0.24	0.32
8674A	Dozaville silt loam, 0 to 2 percent slopes, occasionally flooded	1104.48	0.61%	B	0.24	0.49
871B	LENZBURG GRAVELLY SILTY CLAY LOAM, 1 TO 7 PERCENT SLOPES, STONY	245.45	0.14%	B	0.24	0.37
871D	LENZBURG GRAVELLY SILTY CLAY LOAM, 7 TO 18 PERCENT SLOPES, STONY	81.24	0.04%	B	0.24	0.37
871G	LENZBURG GRAVELLY SILTY CLAY LOAM, 18 TO 70 PERCENT SLOPES, STONY	4.13	0.00%	B	0.24	0.37
8787A	Banlic silt loam, 0 to 2 percent slopes, occasionally flooded	67.08	0.04%	C	0.43	0.55
880B2	Coulterville-Darmstadt silt loams, 2 to 5 percent slopes, eroded	5.59	0.00%	D	0.37	0.49
8831A	Fluvaquents, clayey, 0 to 2 percent slopes, occasionally flooded	326.03	0.18%	0	0.37	0.55
884C3	Bunkum-Coulterville silty clay loams, 5 to 10 percent slopes, severely eroded	490.74	0.27%	C	0.37	0.49

Appendix B Cahokia Canal/Horseshoe Lake Watershed Soil Series Characteristics (continued)						
SSURGO Soil Series Code	**SSURGO Soil Series Code Definition**	**Acres**	**Percent of Watershed**	**Dominant Hydrologic Soil Group**	**Minimum K-factor**	**Maximum K-factor**
886F3	Ruma-Ursa silty clay loams, 18 to 35 percent slopes, severely eroded	2763.49	1.52%	B	0.28	0.37
897D3	Bunkum-Atlas silty clay loams, 10 to 18 percent slopes, severely eroded	1034.60	0.57%	C	0.28	0.49
90A	Bethalto silt loam, 0 to 2 percent slopes	432.14	0.24%	B	0.24	0.49
962D2	Sylvan-Bold silt loams, 10 to 18 percent slopes, eroded	1571.50	0.87%	B	0.37	0.55
962F2	Sylvan-Bold silt loams, 18 to 35 percent slopes, eroded	6570.68	3.62%	B	0.37	0.55
962G	SYLVAN-BOLD SILT LOAMS, 35 TO 60 PERCENT SLOPES	1774.79	0.98%	B	0.37	0.55
M-W	Miscellaneous water	323.16	0.18%	NA	NA	NA
W	Water	10461.87	5.76%	NA	NA	NA
	TOTAL	181636.55	100.00%			

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Appendix C
Water Quality Data

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Water Quality Data
Cahokia Canal/Horseshoe Lake Watershed

Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
JMAC02	1/22/1990	NA	Fecal Coliform cfu/100mL	5900
JMAC02	3/5/1990	NA	Fecal Coliform cfu/100mL	900
JMAC02	4/9/1990	NA	Fecal Coliform cfu/100mL	1000
JMAC02	5/2/1990	NA	Fecal Coliform cfu/100mL	860
JMAC02	6/18/1990	NA	Fecal Coliform cfu/100mL	6000
JMAC02	7/25/1990	NA	Fecal Coliform cfu/100mL	5600
JMAC02	9/5/1990	NA	Fecal Coliform cfu/100mL	1120
JMAC02	10/15/1990	NA	Fecal Coliform cfu/100mL	2700
JMAC02	11/26/1990	NA	Fecal Coliform cfu/100mL	2100
JMAC02	1/16/1991	NA	Fecal Coliform cfu/100mL	3300
JMAC02	2/19/1991	NA	Fecal Coliform cfu/100mL	360
JMAC02	4/23/1991	NA	Fecal Coliform cfu/100mL	700
JMAC02	5/13/1991	NA	Fecal Coliform cfu/100mL	590
JMAC02	6/5/1991	NA	Fecal Coliform cfu/100mL	2400
JMAC02	7/29/1991	NA	Fecal Coliform cfu/100mL	2000
JMAC02	9/3/1991	NA	Fecal Coliform cfu/100mL	5800
JMAC02	10/1/1991	NA	Fecal Coliform cfu/100mL	860
JMAC02	11/25/1991	NA	Fecal Coliform cfu/100mL	2000
JMAC02	1/29/1992	NA	Fecal Coliform cfu/100mL	20000
JMAC02	3/3/1992	NA	Fecal Coliform cfu/100mL	3300
JMAC02	4/20/1992	NA	Fecal Coliform cfu/100mL	9800
JMAC02	5/26/1992	NA	Fecal Coliform cfu/100mL	5800
JMAC02	6/15/1992	NA	Fecal Coliform cfu/100mL	20000
JMAC02	7/29/1992	NA	Fecal Coliform cfu/100mL	1160
JMAC02	8/26/1992	NA	Fecal Coliform cfu/100mL	560
JMAC02	10/27/1992	NA	Fecal Coliform cfu/100mL	380
JMAC02	11/23/1992	NA	Fecal Coliform cfu/100mL	6000
JMAC02	1/6/1993	NA	Fecal Coliform cfu/100mL	2700
JMAC02	2/8/1993	NA	Fecal Coliform cfu/100mL	2700
JMAC02	4/26/1993	NA	Fecal Coliform cfu/100mL	800
JMAC02	6/16/1993	NA	Fecal Coliform cfu/100mL	2200
JMAC02	7/19/1993	NA	Fecal Coliform cfu/100mL	20000
JMAC02	9/8/1993	NA	Fecal Coliform cfu/100mL	2900
JMAC02	11/29/1993	NA	Fecal Coliform cfu/100mL	1000
JMAC02	1/10/1994	NA	Fecal Coliform cfu/100mL	500
JMAC02	2/9/1994	NA	Fecal Coliform cfu/100mL	2800
JMAC02	3/28/1994	NA	Fecal Coliform cfu/100mL	2000
JMAC02	5/4/1994	NA	Fecal Coliform cfu/100mL	20000
JMAC02	6/27/1994	NA	Fecal Coliform cfu/100mL	7900
JMAC02	8/1/1994	NA	Fecal Coliform cfu/100mL	2500
JMAC02	9/26/1994	NA	Fecal Coliform cfu/100mL	9800
JMAC02	11/2/1994	NA	Fecal Coliform cfu/100mL	5100
JMAC02	12/12/1994	NA	Fecal Coliform cfu/100mL	3100
JMAC02	1/23/1995	NA	Fecal Coliform cfu/100mL	3000
JMAC02	3/6/1995	NA	Fecal Coliform cfu/100mL	2800
JMAC02	4/10/1995	NA	Fecal Coliform cfu/100mL	2000
JMAC02	5/22/1995	NA	Fecal Coliform cfu/100mL	4900
JMAC02	6/19/1995	NA	Fecal Coliform cfu/100mL	2000
JMAC02	7/24/1995	NA	Fecal Coliform cfu/100mL	9800
JMAC02	8/28/1995	NA	Fecal Coliform cfu/100mL	2300
JMAC02	10/23/1995	NA	Fecal Coliform cfu/100mL	9800

Water Quality Data
Cahokia Canal/Horseshoe Lake Watershed

Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
JMAC02	11/27/1995	NA	Fecal Coliform cfu/100mL	600
JMAC02	1/8/1996	NA	Fecal Coliform cfu/100mL	200
JMAC02	2/14/1996	NA	Fecal Coliform cfu/100mL	1000
JMAC02	3/20/1996	NA	Fecal Coliform cfu/100mL	1100
JMAC02	4/22/1996	NA	Fecal Coliform cfu/100mL	5900
JMAC02	6/5/1996	NA	Fecal Coliform cfu/100mL	2700
JMAC02	7/17/1996	NA	Fecal Coliform cfu/100mL	3600
JMAC02	9/16/1996	NA	Fecal Coliform cfu/100mL	8000
JMAC02	6/12/2003	NA	Fecal Coliform cfu/100mL	8500
JMAC02	8/12/2003	NA	Fecal Coliform cfu/100mL	400
JMAC02	9/23/2003	NA	Fecal Coliform cfu/100mL	270
JMAC02	10/28/2003	NA	Fecal Coliform cfu/100mL	1950
JMAC02	12/10/2003	NA	Fecal Coliform cfu/100mL	490
JMAC02	2/4/2004	NA	Fecal Coliform cfu/100mL	335
JMAC02	3/16/2004	NA	Fecal Coliform cfu/100mL	960
JMAC02	4/28/2004	NA	Fecal Coliform cfu/100mL	920
JMAC02	6/2/2004	NA	Fecal Coliform cfu/100mL	1320
JMAC02	6/28/2004	NA	Fecal Coliform cfu/100mL	810
JMAC02	8/10/2004	NA	Fecal Coliform cfu/100mL	710
JMAC02	9/27/2004	NA	Fecal Coliform cfu/100mL	165
JMAC02	11/8/2004	NA	Fecal Coliform cfu/100mL	500
JMAC02	12/16/2004	NA	Fecal Coliform cfu/100mL	2300
JN 02	1/11/1999	NA	DISSOLVED OXYGEN (DO) mg/l	7.3
JN 02	3/1/1999	NA	DISSOLVED OXYGEN (DO) mg/l	10.5
JN 02	4/7/1999	NA	DISSOLVED OXYGEN (DO) mg/l	8.7
JN 02	5/3/1999	NA	DISSOLVED OXYGEN (DO) mg/l	9.8
JN 02	6/7/1999	NA	DISSOLVED OXYGEN (DO) mg/l	6.8
JN 02	7/12/1999	NA	DISSOLVED OXYGEN (DO) mg/l	7.8
JN 02	8/23/1999	NA	DISSOLVED OXYGEN (DO) mg/l	8.1
JN 02	10/4/1999	NA	DISSOLVED OXYGEN (DO) mg/l	4
JN 02	11/17/1999	NA	DISSOLVED OXYGEN (DO) mg/l	8
JN 02	2/2/2000	NA	DISSOLVED OXYGEN (DO) mg/l	10.7
JN 02	3/6/2000	NA	DISSOLVED OXYGEN (DO) mg/l	12.1
JN 02	4/17/2000	NA	DISSOLVED OXYGEN (DO) mg/l	7.7
JN 02	5/22/2000	NA	DISSOLVED OXYGEN (DO) mg/l	9.2
JN 02	6/12/2000	NA	DISSOLVED OXYGEN (DO) mg/l	4.8
JN 02	8/9/2000	NA	DISSOLVED OXYGEN (DO) mg/l	5.3
JN 02	9/11/2000	NA	DISSOLVED OXYGEN (DO) mg/l	3.5
JN 02	10/23/2000	NA	DISSOLVED OXYGEN (DO) mg/l	7.4
JN 02	12/11/2000	NA	DISSOLVED OXYGEN (DO) mg/l	9.7
JN 02	1/16/2001	NA	DISSOLVED OXYGEN (DO) mg/l	11.7
JN 02	2/5/2001	NA	DISSOLVED OXYGEN (DO) mg/l	11.5
JN 02	3/26/2001	NA	DISSOLVED OXYGEN (DO) mg/l	12.4
JN 02	4/23/2001	NA	DISSOLVED OXYGEN (DO) mg/l	7.3
JN 02	6/18/2001	NA	DISSOLVED OXYGEN (DO) mg/l	7.2
JN 02	8/1/2001	NA	DISSOLVED OXYGEN (DO) mg/l	8.1
JN 02	10/15/2001	NA	DISSOLVED OXYGEN (DO) mg/l	6.8
JN 02	12/3/2001	NA	DISSOLVED OXYGEN (DO) mg/l	9.9
JN 02	1/23/2002	NA	DISSOLVED OXYGEN (DO) mg/l	10.2
JN 02	3/13/2002	NA	DISSOLVED OXYGEN (DO) mg/l	10.4
JN 02	4/15/2002	NA	DISSOLVED OXYGEN (DO) mg/l	8.5

Water Quality Data
Cahokia Canal/Horseshoe Lake Watershed

Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
JN 02	5/20/2002	NA	DISSOLVED OXYGEN (DO) mg/l	7.8
JN 02	6/24/2002	NA	DISSOLVED OXYGEN (DO) mg/l	6.6
JN 02	7/29/2002	NA	DISSOLVED OXYGEN (DO) mg/l	4
JN 02	9/11/2002	NA	DISSOLVED OXYGEN (DO) mg/l	9.1
JN 02	10/15/2002	NA	DISSOLVED OXYGEN (DO) mg/l	9.2
JN 02	12/2/2002	NA	DISSOLVED OXYGEN (DO) mg/l	9.3
JN 02	1/7/2003	NA	DISSOLVED OXYGEN (DO) mg/l	11.7
JN 02	2/21/2003	NA	DISSOLVED OXYGEN (DO) mg/l	12.1
JN 02	4/1/2003	NA	DISSOLVED OXYGEN (DO) mg/l	8.6
JN 02	5/12/2003	NA	DISSOLVED OXYGEN (DO) mg/l	7.7
JN 02	6/11/2003	NA	DISSOLVED OXYGEN (DO) mg/l	7.2
JN 02	8/12/2003	NA	DISSOLVED OXYGEN (DO) mg/l	2.3
JN 02	9/22/2003	NA	DISSOLVED OXYGEN (DO) mg/l	5.1
JN 02	10/28/2003	NA	DISSOLVED OXYGEN (DO) mg/l	4.5
JN 02	12/10/2003	NA	DISSOLVED OXYGEN (DO) mg/l	8.6
JN 02	1/22/1990	NA	DISSOLVED OXYGEN (DO) mg/l	12.90
JN 02	3/5/1990	NA	DISSOLVED OXYGEN (DO) mg/l	13.90
JN 02	4/9/1990	NA	DISSOLVED OXYGEN (DO) mg/l	8.70
JN 02	5/2/1990	NA	DISSOLVED OXYGEN (DO) mg/l	9.00
JN 02	6/18/1990	NA	DISSOLVED OXYGEN (DO) mg/l	5.90
JN 02	7/18/1990	NA	DISSOLVED OXYGEN (DO) mg/l	5.10
JN 02	7/25/1990	NA	DISSOLVED OXYGEN (DO) mg/l	5.70
JN 02	9/5/1990	NA	DISSOLVED OXYGEN (DO) mg/l	2.80
JN 02	10/15/1990	NA	DISSOLVED OXYGEN (DO) mg/l	6.60
JN 02	11/26/1990	NA	DISSOLVED OXYGEN (DO) mg/l	6.80
JN 02	1/16/1991	NA	DISSOLVED OXYGEN (DO) mg/l	11.30
JN 02	2/19/1991	NA	DISSOLVED OXYGEN (DO) mg/l	9.60
JN 02	4/22/1991	NA	DISSOLVED OXYGEN (DO) mg/l	10.30
JN 02	5/13/1991	NA	DISSOLVED OXYGEN (DO) mg/l	7.10
JN 02	6/5/1991	NA	DISSOLVED OXYGEN (DO) mg/l	6.50
JN 02	7/29/1991	NA	DISSOLVED OXYGEN (DO) mg/l	4.10
JN 02	9/3/1991	NA	DISSOLVED OXYGEN (DO) mg/l	6.60
JN 02	10/1/1991	NA	DISSOLVED OXYGEN (DO) mg/l	6.40
JN 02	11/25/1991	NA	DISSOLVED OXYGEN (DO) mg/l	12.00
JN 02	1/29/1992	NA	DISSOLVED OXYGEN (DO) mg/l	13.10
JN 02	3/3/1992	NA	DISSOLVED OXYGEN (DO) mg/l	10.90
JN 02	4/20/1992	NA	DISSOLVED OXYGEN (DO) mg/l	6.80
JN 02	5/26/1992	NA	DISSOLVED OXYGEN (DO) mg/l	5.50
JN 02	6/15/1992	NA	DISSOLVED OXYGEN (DO) mg/l	5.80
JN 02	7/29/1992	NA	DISSOLVED OXYGEN (DO) mg/l	7.00
JN 02	8/26/1992	NA	DISSOLVED OXYGEN (DO) mg/l	4.00
JN 02	10/27/1992	NA	DISSOLVED OXYGEN (DO) mg/l	4.00
JN 02	11/23/1992	NA	DISSOLVED OXYGEN (DO) mg/l	8.60
JN 02	1/6/1993	NA	DISSOLVED OXYGEN (DO) mg/l	10.90
JN 02	2/8/1993	NA	DISSOLVED OXYGEN (DO) mg/l	10.90
JN 02	3/22/1993	NA	DISSOLVED OXYGEN (DO) mg/l	13.00
JN 02	4/26/1993	NA	DISSOLVED OXYGEN (DO) mg/l	7.40
JN 02	6/16/1993	NA	DISSOLVED OXYGEN (DO) mg/l	6.10
JN 02	7/19/1993	NA	DISSOLVED OXYGEN (DO) mg/l	5.20
JN 02	9/8/1993	NA	DISSOLVED OXYGEN (DO) mg/l	3.50
JN 02	10/25/1993	NA	DISSOLVED OXYGEN (DO) mg/l	8.40

Water Quality Data
Cahokia Canal/Horseshoe Lake Watershed

Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
JN 02	11/29/1993	NA	DISSOLVED OXYGEN (DO) mg/l	9.80
JN 02	1/10/1994	NA	DISSOLVED OXYGEN (DO) mg/l	11.70
JN 02	2/9/1994	NA	DISSOLVED OXYGEN (DO) mg/l	12.00
JN 02	3/28/1994	NA	DISSOLVED OXYGEN (DO) mg/l	12.10
JN 02	5/4/1994	NA	DISSOLVED OXYGEN (DO) mg/l	8.30
JN 02	6/27/1994	NA	DISSOLVED OXYGEN (DO) mg/l	5.40
JN 02	8/1/1994	NA	DISSOLVED OXYGEN (DO) mg/l	3.90
JN 02	9/26/1994	NA	DISSOLVED OXYGEN (DO) mg/l	7.70
JN 02	11/2/1994	NA	DISSOLVED OXYGEN (DO) mg/l	10.60
JN 02	12/12/1994	NA	DISSOLVED OXYGEN (DO) mg/l	11.10
JN 02	1/23/1995	NA	DISSOLVED OXYGEN (DO) mg/l	11.50
JN 02	3/6/1995	NA	DISSOLVED OXYGEN (DO) mg/l	11.40
JN 02	4/10/1995	NA	DISSOLVED OXYGEN (DO) mg/l	9.40
JN 02	5/22/1995	NA	DISSOLVED OXYGEN (DO) mg/l	5.10
JN 02	6/19/1995	NA	DISSOLVED OXYGEN (DO) mg/l	5.80
JN 02	7/24/1995	NA	DISSOLVED OXYGEN (DO) mg/l	4.30
JN 02	8/28/1995	NA	DISSOLVED OXYGEN (DO) mg/l	5.30
JN 02	10/23/1995	NA	DISSOLVED OXYGEN (DO) mg/l	3.70
JN 02	11/27/1995	NA	DISSOLVED OXYGEN (DO) mg/l	5.00
JN 02	1/8/1996	NA	DISSOLVED OXYGEN (DO) mg/l	11.00
JN 02	2/14/1996	NA	DISSOLVED OXYGEN (DO) mg/l	12.40
JN 02	3/20/1996	NA	DISSOLVED OXYGEN (DO) mg/l	13.60
JN 02	4/22/1996	NA	DISSOLVED OXYGEN (DO) mg/l	7.50
JN 02	6/5/1996	NA	DISSOLVED OXYGEN (DO) mg/l	7.40
JN 02	7/17/1996	NA	DISSOLVED OXYGEN (DO) mg/l	7.20
JN 02	9/16/1996	NA	DISSOLVED OXYGEN (DO) mg/l	5.60
JN 02	10/21/1996	NA	DISSOLVED OXYGEN (DO) mg/l	4.40
JN 02	11/18/1996	NA	DISSOLVED OXYGEN (DO) mg/l	9.00
JN 02	1/21/1997	NA	DISSOLVED OXYGEN (DO) mg/l	12.90
JN 02	3/19/1997	NA	DISSOLVED OXYGEN (DO) mg/l	9.90
JN 02	4/21/1997	NA	DISSOLVED OXYGEN (DO) mg/l	8.70
JN 02	5/27/1997	NA	DISSOLVED OXYGEN (DO) mg/l	10.90
JN 02	7/9/1997	NA	DISSOLVED OXYGEN (DO) mg/l	8.20
JN 02	8/13/1997	NA	DISSOLVED OXYGEN (DO) mg/l	7.90
JN 02	9/24/1997	NA	DISSOLVED OXYGEN (DO) mg/l	4.90
JN 02	11/3/1997	NA	DISSOLVED OXYGEN (DO) mg/l	7.60
JN 02	12/8/1997	NA	DISSOLVED OXYGEN (DO) mg/l	11.70
JN 02	1/20/1998	NA	DISSOLVED OXYGEN (DO) mg/l	12.60
JN 02	3/2/1998	NA	DISSOLVED OXYGEN (DO) mg/l	12.00
JN 02	4/13/1998	NA	DISSOLVED OXYGEN (DO) mg/l	7.40
JN 02	5/26/1998	NA	DISSOLVED OXYGEN (DO) mg/l	5.80
JN 02	6/22/1998	NA	DISSOLVED OXYGEN (DO) mg/l	5.60
JN 02	8/17/1998	NA	DISSOLVED OXYGEN (DO) mg/l	6.60
JN 02	9/14/1998	NA	DISSOLVED OXYGEN (DO) mg/l	5.50
JN 02	10/19/1998	NA	DISSOLVED OXYGEN (DO) mg/l	7.20
JN 02	12/14/1998	NA	DISSOLVED OXYGEN (DO) mg/l	11.00
JNA 01	1/22/1990	NA	MANGANESE, TOTAL (UG/L AS MN)	527
JNA 01	3/5/1990	NA	MANGANESE, TOTAL (UG/L AS MN)	729
JNA 01	4/9/1990	NA	MANGANESE, TOTAL (UG/L AS MN)	775
JNA 01	5/2/1990	NA	MANGANESE, TOTAL (UG/L AS MN)	297
JNA 01	6/18/1990	NA	MANGANESE, TOTAL (UG/L AS MN)	961

Water Quality Data
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Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
JNA 01	7/18/1990	NA	MANGANESE, TOTAL (UG/L AS MN)	152
JNA 01	7/25/1990	NA	MANGANESE, TOTAL (UG/L AS MN)	265
JNA 01	9/5/1990	NA	MANGANESE, TOTAL (UG/L AS MN)	127
JNA 01	10/15/1990	NA	MANGANESE, TOTAL (UG/L AS MN)	167
JNA 01	11/26/1990	NA	MANGANESE, TOTAL (UG/L AS MN)	116
JNA 01	1/16/1991	NA	MANGANESE, TOTAL (UG/L AS MN)	467
JNA 01	2/19/1991	NA	MANGANESE, TOTAL (UG/L AS MN)	921
JNA 01	4/23/1991	NA	MANGANESE, TOTAL (UG/L AS MN)	418
JNA 01	5/13/1991	NA	MANGANESE, TOTAL (UG/L AS MN)	410
JNA 01	6/5/1991	NA	MANGANESE, TOTAL (UG/L AS MN)	160
JNA 01	7/29/1991	NA	MANGANESE, TOTAL (UG/L AS MN)	107
JNA 01	9/3/1991	NA	MANGANESE, TOTAL (UG/L AS MN)	230
JNA 01	10/1/1991	NA	MANGANESE, TOTAL (UG/L AS MN)	68
JNA 01	11/25/1991	NA	MANGANESE, TOTAL (UG/L AS MN)	510
JNA 01	1/29/1992	NA	MANGANESE, TOTAL (UG/L AS MN)	860
JNA 01	3/3/1992	NA	MANGANESE, TOTAL (UG/L AS MN)	710
JNA 01	4/20/1992	NA	MANGANESE, TOTAL (UG/L AS MN)	520
JNA 01	5/26/1992	NA	MANGANESE, TOTAL (UG/L AS MN)	280
JNA 01	6/15/1992	NA	MANGANESE, TOTAL (UG/L AS MN)	160
JNA 01	7/29/1992	NA	MANGANESE, TOTAL (UG/L AS MN)	220
JNA 01	8/26/1992	NA	MANGANESE, TOTAL (UG/L AS MN)	120
JNA 01	10/27/1992	NA	MANGANESE, TOTAL (UG/L AS MN)	88
JNA 01	11/23/1992	NA	MANGANESE, TOTAL (UG/L AS MN)	400
JNA 01	1/6/1993	NA	MANGANESE, TOTAL (UG/L AS MN)	390
JNA 01	2/8/1993	NA	MANGANESE, TOTAL (UG/L AS MN)	800
JNA 01	3/22/1993	NA	MANGANESE, TOTAL (UG/L AS MN)	480
JNA 01	4/26/1993	NA	MANGANESE, TOTAL (UG/L AS MN)	340
JNA 01	6/16/1993	NA	MANGANESE, TOTAL (UG/L AS MN)	220
JNA 01	7/19/1993	NA	MANGANESE, TOTAL (UG/L AS MN)	350
JNA 01	9/8/1993	NA	MANGANESE, TOTAL (UG/L AS MN)	130
JNA 01	10/25/1993	NA	MANGANESE, TOTAL (UG/L AS MN)	300
JNA 01	11/29/1993	NA	MANGANESE, TOTAL (UG/L AS MN)	590
JNA 01	1/10/1994	NA	MANGANESE, TOTAL (UG/L AS MN)	820
JNA 01	2/9/1994	NA	MANGANESE, TOTAL (UG/L AS MN)	510
JNA 01	3/28/1994	NA	MANGANESE, TOTAL (UG/L AS MN)	450
JNA 01	5/4/1994	NA	MANGANESE, TOTAL (UG/L AS MN)	370
JNA 01	6/27/1994	NA	MANGANESE, TOTAL (UG/L AS MN)	390
JNA 01	8/1/1994	NA	MANGANESE, TOTAL (UG/L AS MN)	75
JNA 01	9/26/1994	NA	MANGANESE, TOTAL (UG/L AS MN)	1100
JNA 01	11/2/1994	NA	MANGANESE, TOTAL (UG/L AS MN)	120
JNA 01	12/12/1994	NA	MANGANESE, TOTAL (UG/L AS MN)	480
JNA 01	1/23/1995	NA	MANGANESE, TOTAL (UG/L AS MN)	530
JNA 01	3/6/1995	NA	MANGANESE, TOTAL (UG/L AS MN)	640
JNA 01	4/10/1995	NA	MANGANESE, TOTAL (UG/L AS MN)	380
JNA 01	5/22/1995	NA	MANGANESE, TOTAL (UG/L AS MN)	400
JNA 01	6/19/1995	NA	MANGANESE, TOTAL (UG/L AS MN)	630
JNA 01	7/24/1995	NA	MANGANESE, TOTAL (UG/L AS MN)	310
JNA 01	8/28/1995	NA	MANGANESE, TOTAL (UG/L AS MN)	860
JNA 01	10/23/1995	NA	MANGANESE, TOTAL (UG/L AS MN)	190
JNA 01	11/27/1995	NA	MANGANESE, TOTAL (UG/L AS MN)	140
JNA 01	1/8/1996	NA	MANGANESE, TOTAL (UG/L AS MN)	540

Water Quality Data
Cahokia Canal/Horseshoe Lake Watershed

Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
JNA 01	2/14/1996	NA	MANGANESE, TOTAL (UG/L AS MN)	560
JNA 01	3/20/1996	NA	MANGANESE, TOTAL (UG/L AS MN)	180
JNA 01	4/22/1996	NA	MANGANESE, TOTAL (UG/L AS MN)	3800
JNA 01	6/5/1996	NA	MANGANESE, TOTAL (UG/L AS MN)	430
JNA 01	7/17/1996	NA	MANGANESE, TOTAL (UG/L AS MN)	190
JNA 01	9/16/1996	NA	MANGANESE, TOTAL (UG/L AS MN)	210
JNA 01	10/21/1996	NA	MANGANESE, TOTAL (UG/L AS MN)	250
JNA 01	11/18/1996	NA	MANGANESE, TOTAL (UG/L AS MN)	510
JNA 01	1/21/1997	NA	MANGANESE, TOTAL (UG/L AS MN)	590
JNA 01	3/19/1997	NA	MANGANESE, TOTAL (UG/L AS MN)	410
JNA 01	4/21/1997	NA	MANGANESE, TOTAL (UG/L AS MN)	600
JNA 01	5/27/1997	NA	MANGANESE, TOTAL (UG/L AS MN)	400
JNA 01	7/9/1997	NA	MANGANESE, TOTAL (UG/L AS MN)	220
JNA 01	8/13/1997	NA	MANGANESE, TOTAL (UG/L AS MN)	100
JNA 01	9/24/1997	NA	MANGANESE, TOTAL (UG/L AS MN)	150
JNA 01	11/3/1997	NA	MANGANESE, TOTAL (UG/L AS MN)	120
JNA 01	12/8/1997	NA	MANGANESE, TOTAL (UG/L AS MN)	180
JNA 01	1/20/1998	NA	MANGANESE, TOTAL (UG/L AS MN)	510
JNA 01	3/2/1998	NA	MANGANESE, TOTAL (UG/L AS MN)	540
JNA 01	4/13/1998	NA	MANGANESE, TOTAL (UG/L AS MN)	370
JNA 01	5/26/1998	NA	MANGANESE, TOTAL (UG/L AS MN)	360
JNA 01	6/22/1998	NA	MANGANESE, TOTAL (UG/L AS MN)	230
JNA 01	8/17/1998	NA	MANGANESE, TOTAL (UG/L AS MN)	170
JNA 01	9/14/1998	NA	MANGANESE, TOTAL (UG/L AS MN)	130
JNA 01	10/19/1998	NA	MANGANESE, TOTAL (UG/L AS MN)	120
JNA 01	12/14/1998	NA	MANGANESE, TOTAL (UG/L AS MN)	240
JNA 02	9/17/1998	NA	MANGANESE, TOTAL (UG/L AS MN)	270
RJC-1	4/6/1993	1	PH (STANDARD UNITS)	8.20
RJC-1	6/24/1993	1	PH (STANDARD UNITS)	8.00
RJC-1	7/21/1993	1	PH (STANDARD UNITS)	8.20
RJC-1	8/23/1993	1	PH (STANDARD UNITS)	8.70
RJC-1	10/18/1993	1	PH (STANDARD UNITS)	8.10
RJC-1	5/8/1996	1	PH (STANDARD UNITS)	8.70
RJC-1	6/26/1996	1	PH (STANDARD UNITS)	8.80
RJC-1	7/25/1996	1	PH (STANDARD UNITS)	8.50
RJC-1	8/30/1996	1	PH (STANDARD UNITS)	8.40
RJC-1	10/8/1996	1	PH (STANDARD UNITS)	8.80
RJC-1	5/7/1999	1	PH (STANDARD UNITS)	7.60
RJC-1	6/9/1999	1	PH (STANDARD UNITS)	8.30
RJC-1	7/14/1999	1	PH (STANDARD UNITS)	8.40
RJC-1	8/25/1999	1	PH (STANDARD UNITS)	8.10
RJC-1	10/25/1999	1	PH (STANDARD UNITS)	8.40
RJC-1	4/23/2002	1	PH (STANDARD UNITS)	8.40
RJC-1	6/12/2002	1	PH (STANDARD UNITS)	8.50
RJC-1	8/14/2002	1	PH (STANDARD UNITS)	8.00
RJC-1	10/16/2002	1	PH (STANDARD UNITS)	8.00
RJC-1	4/6/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RJC-1	4/6/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RJC-1	6/24/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJC-1	6/24/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJC-1	7/21/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13

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Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJC-1	7/21/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJC-1	8/23/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.19
RJC-1	8/23/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.19
RJC-1	10/18/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJC-1	10/18/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJC-1	5/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RJC-1	5/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RJC-1	6/26/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJC-1	6/26/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJC-1	7/25/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJC-1	7/25/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJC-1	8/30/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.20
RJC-1	8/30/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.20
RJC-1	10/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RJC-1	10/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RJC-1	5/25/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJC-1	5/25/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJC-1	6/12/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJC-1	6/12/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJC-1	7/10/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.19
RJC-1	7/10/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.19
RJC-1	8/7/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.30
RJC-1	8/7/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.30
RJC-1	9/27/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJC-1	9/27/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJC-1	5/26/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJC-1	5/26/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJC-1	7/17/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RJC-1	7/17/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RJC-1	8/14/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJC-1	8/14/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJC-1	9/26/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RJC-1	9/26/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RJC-1	10/11/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.17
RJC-1	10/11/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.17
RJC-1	5/7/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.06
RJC-1	5/7/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.06
RJC-1	6/9/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.06
RJC-1	6/9/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.06
RJC-1	7/14/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.97
RJC-1	7/14/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.97
RJC-1	8/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RJC-1	8/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RJC-1	10/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJC-1	10/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJC-1	4/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJC-1	4/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJC-1	6/12/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJC-1	6/12/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJC-1	8/14/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJC-1	8/14/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22

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Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJC-1	10/16/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.19
RJC-1	10/16/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.19
RJC-2	4/6/1993	1	PH (STANDARD UNITS)	8.10
RJC-2	6/24/1993	1	PH (STANDARD UNITS)	8.00
RJC-2	7/21/1993	1	PH (STANDARD UNITS)	8.00
RJC-2	8/23/1993	1	PH (STANDARD UNITS)	8.70
RJC-2	10/18/1993	1	PH (STANDARD UNITS)	8.10
RJC-2	5/8/1996	1	PH (STANDARD UNITS)	8.60
RJC-2	6/26/1996	1	PH (STANDARD UNITS)	8.80
RJC-2	7/25/1996	1	PH (STANDARD UNITS)	8.90
RJC-2	8/30/1996	1	PH (STANDARD UNITS)	9.00
RJC-2	10/8/1996	1	PH (STANDARD UNITS)	8.80
RJC-2	5/7/1999	1	PH (STANDARD UNITS)	8.20
RJC-2	6/9/1999	1	PH (STANDARD UNITS)	8.50
RJC-2	7/14/1999	1	PH (STANDARD UNITS)	8.60
RJC-2	8/25/1999	1	PH (STANDARD UNITS)	8.90
RJC-2	10/25/1999	1	PH (STANDARD UNITS)	8.90
RJC-2	4/23/2002	1	PH (STANDARD UNITS)	8.70
RJC-2	6/12/2002	1	PH (STANDARD UNITS)	8.80
RJC-2	8/14/2002	1	PH (STANDARD UNITS)	8.50
RJC-2	10/16/2002	1	PH (STANDARD UNITS)	8.80
RJC-2	4/6/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.05
RJC-2	4/6/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.05
RJC-2	6/24/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJC-2	6/24/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJC-2	7/21/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.20
RJC-2	7/21/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.20
RJC-2	8/23/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.19
RJC-2	8/23/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.19
RJC-2	10/18/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJC-2	10/18/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJC-2	5/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJC-2	5/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJC-2	6/26/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJC-2	6/26/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJC-2	7/25/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.31
RJC-2	7/25/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.31
RJC-2	8/30/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.29
RJC-2	8/30/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.29
RJC-2	10/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJC-2	10/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJC-2	5/7/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJC-2	5/7/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJC-2	6/9/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJC-2	6/9/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJC-2	7/14/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJC-2	7/14/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJC-2	8/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJC-2	8/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJC-2	10/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.07
RJC-2	10/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.07

Water Quality Data
Cahokia Canal/Horseshoe Lake Watershed

Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJC-2	4/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.96
RJC-2	4/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.96
RJC-2	6/12/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJC-2	6/12/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJC-2	8/14/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.30
RJC-2	8/14/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.30
RJC-2	10/16/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RJC-2	10/16/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RJC-3	4/6/1993	1	PH (STANDARD UNITS)	8.30
RJC-3	6/24/1993	1	PH (STANDARD UNITS)	8.30
RJC-3	7/21/1993	1	PH (STANDARD UNITS)	8.10
RJC-3	8/23/1993	1	PH (STANDARD UNITS)	9.00
RJC-3	10/18/1993	1	PH (STANDARD UNITS)	8.60
RJC-3	5/8/1996	1	PH (STANDARD UNITS)	8.80
RJC-3	6/26/1996	1	PH (STANDARD UNITS)	9.30
RJC-3	7/25/1996	1	PH (STANDARD UNITS)	8.70
RJC-3	8/30/1996	1	PH (STANDARD UNITS)	8.70
RJC-3	10/8/1996	1	PH (STANDARD UNITS)	9.00
RJC-3	5/7/1999	1	PH (STANDARD UNITS)	8.50
RJC-3	6/9/1999	1	PH (STANDARD UNITS)	8.90
RJC-3	7/14/1999	1	PH (STANDARD UNITS)	9.20
RJC-3	8/25/1999	1	PH (STANDARD UNITS)	8.80
RJC-3	10/25/1999	1	PH (STANDARD UNITS)	8.80
RJC-3	4/23/2002	1	PH (STANDARD UNITS)	8.60
RJC-3	7/17/2002	1	PH (STANDARD UNITS)	9.10
RJC-3	8/14/2002	1	PH (STANDARD UNITS)	8.70
RJC-3	10/16/2002	1	PH (STANDARD UNITS)	8.70
RJC-3	4/6/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RJC-3	4/6/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RJC-3	6/24/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJC-3	6/24/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJC-3	7/21/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJC-3	7/21/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJC-3	8/23/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJC-3	8/23/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJC-3	10/18/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJC-3	10/18/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJC-3	5/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJC-3	5/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJC-3	6/26/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJC-3	6/26/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJC-3	7/25/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJC-3	7/25/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJC-3	8/30/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.21
RJC-3	8/30/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.21
RJC-3	10/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJC-3	10/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJC-3	5/7/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.50
RJC-3	5/7/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.50
RJC-3	6/9/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.50
RJC-3	6/9/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.50

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Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJC-3	7/14/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJC-3	7/14/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJC-3	8/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJC-3	8/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJC-3	10/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RJC-3	10/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RJC-3	4/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJC-3	4/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJC-3	7/17/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.21
RJC-3	7/17/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.21
RJC-3	8/14/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.21
RJC-3	8/14/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.21
RJC-3	10/16/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.17
RJC-3	10/16/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.17
RJC-4	4/6/1993	1	PH (STANDARD UNITS)	8.20
RJC-4	6/24/1993	1	PH (STANDARD UNITS)	8.20
RJC-4	7/21/1993	1	PH (STANDARD UNITS)	7.80
RJC-4	8/23/1993	1	PH (STANDARD UNITS)	9.10
RJC-4	10/18/1993	1	PH (STANDARD UNITS)	8.50
RJC-4	5/8/1996	1	PH (STANDARD UNITS)	8.70
RJC-4	6/26/1996	1	PH (STANDARD UNITS)	8.80
RJC-4	7/25/1996	1	PH (STANDARD UNITS)	8.90
RJC-4	8/30/1996	1	PH (STANDARD UNITS)	8.80
RJC-4	10/8/1996	1	PH (STANDARD UNITS)	8.90
RJC-4	5/7/1999	1	PH (STANDARD UNITS)	8.20
RJC-4	6/9/1999	1	PH (STANDARD UNITS)	8.80
RJC-4	7/14/1999	1	PH (STANDARD UNITS)	8.90
RJC-4	8/25/1999	1	PH (STANDARD UNITS)	8.80
RJC-4	10/25/1999	1	PH (STANDARD UNITS)	8.90
RJC-4	4/23/2002	1	PH (STANDARD UNITS)	8.80
RJC-4	7/17/2002	1	PH (STANDARD UNITS)	9.00
RJC-4	8/14/2002	1	PH (STANDARD UNITS)	8.80
RJC-4	10/16/2002	1	PH (STANDARD UNITS)	8.80
RJC-4	4/6/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.05
RJC-4	4/6/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.05
RJC-4	6/24/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJC-4	6/24/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJC-4	7/21/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.17
RJC-4	7/21/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.17
RJC-4	8/23/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.20
RJC-4	8/23/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.20
RJC-4	10/18/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJC-4	10/18/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJC-4	5/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJC-4	5/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJC-4	6/26/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJC-4	6/26/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJC-4	7/25/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJC-4	7/25/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJC-4	8/30/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.39
RJC-4	8/30/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.39

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Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJC-4	10/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJC-4	10/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJC-4	5/7/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.90
RJC-4	5/7/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.90
RJC-4	6/9/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RJC-4	6/9/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RJC-4	7/14/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJC-4	7/14/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJC-4	8/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJC-4	8/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJC-4	10/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.07
RJC-4	10/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.07
RJC-4	4/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJC-4	4/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJC-4	7/17/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.43
RJC-4	7/17/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.43
RJC-4	8/14/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.35
RJC-4	8/14/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.35
RJC-4	10/16/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.17
RJC-4	10/16/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.17
RJK-1	5/30/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RJK-1	5/30/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RJK-1	6/30/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJK-1	6/30/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJK-1	7/16/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJK-1	7/16/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJK-1	10/10/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.27
RJK-1	10/10/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJK-1	10/10/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.45
RJK-1	10/10/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJK-1	10/10/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.34
RJK-1	10/10/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RJK-1	10/10/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.27
RJK-1	10/10/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJK-1	10/10/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.45
RJK-1	10/10/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJK-1	10/10/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.34
RJK-1	10/10/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RJK-1	11/5/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJK-1	11/5/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJK-1	11/27/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.51
RJK-1	11/27/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.30
RJK-1	11/27/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.51
RJK-1	11/27/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.30
RJK-1	11/28/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.55
RJK-1	11/28/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.53
RJK-1	11/28/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.61
RJK-1	11/28/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.55
RJK-1	11/28/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.53
RJK-1	11/28/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.61
RJK-1	12/17/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.37

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Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJK-1	12/17/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	3.40
RJK-1	12/17/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.41
RJK-1	12/17/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.37
RJK-1	12/17/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	3.40
RJK-1	12/17/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.41
RJK-1	12/18/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	12/18/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJK-1	12/18/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJK-1	12/18/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	12/18/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJK-1	12/18/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJK-1	3/19/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.20
RJK-1	3/19/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	3/19/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.19
RJK-1	3/19/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.20
RJK-1	3/19/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	3/19/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.19
RJK-1	10/22/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.43
RJK-1	10/22/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.43
RJK-1	12/3/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.23
RJK-1	12/3/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.23
RJK-1	12/12/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJK-1	12/12/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJK-1	12/26/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJK-1	12/26/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJK-1	1/29/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RJK-1	1/29/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RJK-1	2/27/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	2/27/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	3/11/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	3/11/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	4/9/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJK-1	4/9/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJK-1	4/21/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.28
RJK-1	4/21/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.28
RJK-1	5/5/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.29
RJK-1	5/5/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.29
RJK-1	5/15/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJK-1	5/15/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJK-1	5/28/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	5/28/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	6/8/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.17
RJK-1	6/8/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.17
RJK-1	6/22/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	6/22/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	7/20/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.32
RJK-1	7/20/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.32
RJK-1	8/3/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.39
RJK-1	8/3/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.39
RJK-1	8/17/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.58
RJK-1	8/17/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.58

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Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJK-1	8/28/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.20
RJK-1	8/28/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.20
RJK-1	9/10/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJK-1	9/10/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJK-1	9/23/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	1.64
RJK-1	9/23/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	1.64
RJK-1	10/8/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	1.85
RJK-1	10/8/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	1.85
RJK-1	11/2/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJK-1	11/2/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJK-1	11/16/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.17
RJK-1	11/16/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.17
RJK-1	11/30/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.30
RJK-1	11/30/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.30
RJK-1	12/15/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.26
RJK-1	12/15/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.31
RJK-1	12/15/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.26
RJK-1	12/15/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.31
RJK-1	12/16/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.46
RJK-1	12/16/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.40
RJK-1	12/16/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.46
RJK-1	12/16/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.40
RJK-1	6/30/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RJK-1	6/30/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RJK-1	7/20/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	7/20/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	8/31/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJK-1	8/31/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJK-1	9/30/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.01
RJK-1	9/30/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.01
RJK-1	10/21/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJK-1	10/21/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJK-1	10/31/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.06
RJK-1	10/31/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.06
RJK-1	5/25/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	5/25/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	6/12/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RJK-1	6/12/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RJK-1	7/10/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJK-1	7/10/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJK-1	8/9/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.21
RJK-1	8/9/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.21
RJK-1	9/27/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.21
RJK-1	9/27/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.21
RJK-1	10/31/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJK-1	10/31/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJK-1	5/26/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJK-1	5/26/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJK-1	7/25/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	7/25/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJK-1	8/22/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.20

Water Quality Data
Cahokia Canal/Horseshoe Lake Watershed

Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJK-1	8/22/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.20
RJK-1	9/21/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJK-1	9/21/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJK-1	10/11/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJK-1	10/11/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJK-1	5/6/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.057
RJK-1	5/6/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.057
RJK-1	6/9/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.051
RJK-1	6/9/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.051
RJK-1	7/14/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.073
RJK-1	7/14/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.073
RJK-1	8/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.078
RJK-1	8/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.078
RJK-1	10/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.061
RJK-1	10/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.061
RJK-1	4/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.112
RJK-1	4/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.112
RJK-1	6/12/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.126
RJK-1	6/12/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.126
RJK-1	7/17/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJK-1	7/17/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJK-1	8/14/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.184
RJK-1	8/14/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.184
RJK-1	10/16/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.169
RJK-1	10/16/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.169
RJK-1	5/30/1990	1	Total Phosphorus, mg/L	0.18
RJK-1	6/30/1990	1	Total Phosphorus, mg/L	0.22
RJK-1	7/16/1990	1	Total Phosphorus, mg/L	0.11
RJK-1	10/10/1990	1	Total Phosphorus, mg/L	0.27
RJK-1	10/10/1990	1	Total Phosphorus, mg/L	0.11
RJK-1	10/10/1990	1	Total Phosphorus, mg/L	0.45
RJK-1	10/10/1990	1	Total Phosphorus, mg/L	0.12
RJK-1	10/10/1990	1	Total Phosphorus, mg/L	0.34
RJK-1	10/10/1990	1	Total Phosphorus, mg/L	0.10
RJK-1	11/5/1990	1	Total Phosphorus, mg/L	0.22
RJK-1	11/27/1990	1	Total Phosphorus, mg/L	0.51
RJK-1	11/27/1990	1	Total Phosphorus, mg/L	0.30
RJK-1	11/28/1990	1	Total Phosphorus, mg/L	0.55
RJK-1	11/28/1990	1	Total Phosphorus, mg/L	0.53
RJK-1	11/28/1990	1	Total Phosphorus, mg/L	0.61
RJK-1	12/17/1990	1	Total Phosphorus, mg/L	0.37
RJK-1	12/17/1990	1	Total Phosphorus, mg/L	3.40
RJK-1	12/17/1990	1	Total Phosphorus, mg/L	0.41
RJK-1	12/18/1990	1	Total Phosphorus, mg/L	0.16
RJK-1	12/18/1990	1	Total Phosphorus, mg/L	0.13
RJK-1	12/18/1990	1	Total Phosphorus, mg/L	0.15
RJK-1	3/19/1991	1	Total Phosphorus, mg/L	0.20
RJK-1	3/19/1991	1	Total Phosphorus, mg/L	0.16
RJK-1	3/19/1991	1	Total Phosphorus, mg/L	0.19
RJK-1	10/22/1991	1	Total Phosphorus, mg/L	0.43
RJK-1	12/3/1991	1	Total Phosphorus, mg/L	0.23

Water Quality Data
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Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJK-1	12/12/1991	1	Total Phosphorus, mg/L	0.11
RJK-1	12/26/1991	1	Total Phosphorus, mg/L	0.08
RJK-1	1/29/1992	1	Total Phosphorus, mg/L	0.10
RJK-1	2/27/1992	1	Total Phosphorus, mg/L	0.16
RJK-1	3/11/1992	1	Total Phosphorus, mg/L	0.16
RJK-1	4/9/1992	1	Total Phosphorus, mg/L	0.12
RJK-1	4/21/1992	1	Total Phosphorus, mg/L	0.28
RJK-1	5/5/1992	1	Total Phosphorus, mg/L	0.29
RJK-1	5/15/1992	1	Total Phosphorus, mg/L	0.12
RJK-1	5/28/1992	1	Total Phosphorus, mg/L	0.16
RJK-1	6/8/1992	1	Total Phosphorus, mg/L	0.17
RJK-1	6/22/1992	1	Total Phosphorus, mg/L	0.16
RJK-1	7/20/1992	1	Total Phosphorus, mg/L	0.32
RJK-1	8/3/1992	1	Total Phosphorus, mg/L	0.39
RJK-1	8/17/1992	1	Total Phosphorus, mg/L	0.58
RJK-1	8/28/1992	1	Total Phosphorus, mg/L	0.20
RJK-1	9/10/1992	1	Total Phosphorus, mg/L	0.13
RJK-1	9/23/1992	1	Total Phosphorus, mg/L	1.64
RJK-1	10/8/1992	1	Total Phosphorus, mg/L	1.85
RJK-1	11/2/1992	1	Total Phosphorus, mg/L	0.13
RJK-1	11/16/1992	1	Total Phosphorus, mg/L	0.17
RJK-1	11/30/1992	1	Total Phosphorus, mg/L	0.30
RJK-1	12/15/1992	1	Total Phosphorus, mg/L	0.26
RJK-1	12/15/1992	1	Total Phosphorus, mg/L	0.31
RJK-1	12/16/1992	1	Total Phosphorus, mg/L	0.46
RJK-1	12/16/1992	1	Total Phosphorus, mg/L	0.40
RJK-1	6/30/1996	1	Total Phosphorus, mg/L	0.09
RJK-1	7/20/1996	1	Total Phosphorus, mg/L	0.16
RJK-1	8/31/1996	1	Total Phosphorus, mg/L	0.22
RJK-1	9/30/1996	1	Total Phosphorus, mg/L	0.01
RJK-1	10/21/1996	1	Total Phosphorus, mg/L	0.14
RJK-1	10/31/1996	1	Total Phosphorus, mg/L	0.06
RJK-1	5/25/1997	1	Total Phosphorus, mg/L	0.16
RJK-1	6/12/1997	1	Total Phosphorus, mg/L	0.09
RJK-1	7/10/1997	1	Total Phosphorus, mg/L	0.14
RJK-1	8/9/1997	1	Total Phosphorus, mg/L	0.21
RJK-1	9/27/1997	1	Total Phosphorus, mg/L	0.21
RJK-1	10/31/1997	1	Total Phosphorus, mg/L	0.14
RJK-1	5/26/1998	1	Total Phosphorus, mg/L	0.12
RJK-1	7/25/1998	1	Total Phosphorus, mg/L	0.16
RJK-1	8/22/1998	1	Total Phosphorus, mg/L	0.20
RJK-1	9/21/1998	1	Total Phosphorus, mg/L	0.15
RJK-1	10/11/1998	1	Total Phosphorus, mg/L	0.15
RJK-1	5/6/1999	1	Total Phosphorus, mg/L	0.06
RJK-1	6/9/1999	1	Total Phosphorus, mg/L	0.05
RJK-1	7/14/1999	1	Total Phosphorus, mg/L	0.07
RJK-1	8/25/1999	1	Total Phosphorus, mg/L	0.08
RJK-1	10/25/1999	1	Total Phosphorus, mg/L	0.06
RJK-1	4/23/2002	1	Total Phosphorus, mg/L	0.11
RJK-1	6/12/2002	1	Total Phosphorus, mg/L	0.13
RJK-1	7/17/2002	1	Total Phosphorus, mg/L	0.13

Water Quality Data
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Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJK-1	8/14/2002	1	Total Phosphorus, mg/L	0.18
RJK-1	10/16/2002	1	Total Phosphorus, mg/L	0.17
RJL-1	1/17/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJL-1	1/17/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJL-1	2/14/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJL-1	2/14/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJL-1	3/21/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJL-1	3/21/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJL-1	4/23/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJL-1	4/23/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJL-1	5/16/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJL-1	5/16/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RJL-1	5/24/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	5/24/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	5/30/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RJL-1	5/30/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RJL-1	6/7/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJL-1	6/7/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJL-1	6/30/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RJL-1	6/30/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RJL-1	7/9/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	7/9/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	7/16/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RJL-1	7/16/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RJL-1	8/13/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJL-1	8/13/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJL-1	9/19/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJL-1	9/19/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJL-1	10/9/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJL-1	10/9/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJL-1	11/7/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJL-1	11/7/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJL-1	12/11/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJL-1	12/11/1990	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJL-1	2/21/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RJL-1	2/21/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RJL-1	3/19/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RJL-1	3/19/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RJL-1	4/17/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJL-1	4/17/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJL-1	5/14/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RJL-1	5/14/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RJL-1	6/13/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJL-1	6/13/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJL-1	7/11/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	7/11/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	8/22/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.17
RJL-1	8/22/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.17
RJL-1	9/4/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.28
RJL-1	9/4/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	9/4/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.44

Water Quality Data
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Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJL-1	9/4/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	9/4/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	9/4/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJL-1	9/4/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.28
RJL-1	9/4/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	9/4/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.44
RJL-1	9/4/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	9/4/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	9/4/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RJL-1	9/18/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.19
RJL-1	9/18/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJL-1	9/18/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJL-1	9/18/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJL-1	9/18/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJL-1	9/18/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJL-1	9/18/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.19
RJL-1	9/18/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJL-1	9/18/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJL-1	9/18/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJL-1	9/18/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJL-1	9/18/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJL-1	9/20/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.32
RJL-1	9/20/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.32
RJL-1	10/22/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	10/22/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	11/19/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJL-1	11/19/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJL-1	12/12/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJL-1	12/12/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RJL-1	4/9/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJL-1	4/9/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJL-1	6/22/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJL-1	6/22/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJL-1	7/15/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJL-1	7/15/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJL-1	7/15/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJL-1	7/15/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RJL-1	7/15/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJL-1	7/15/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RJL-1	7/20/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	7/20/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	8/17/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.20
RJL-1	8/17/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.20
RJL-1	10/19/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	10/19/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	5/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJL-1	5/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RJL-1	6/26/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJL-1	6/26/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RJL-1	7/26/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RJL-1	7/26/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18

Water Quality Data
Cahokia Canal/Horseshoe Lake Watershed

Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJL-1	8/30/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RJL-1	8/30/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RJL-1	10/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	10/8/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RJL-1	5/6/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.053
RJL-1	5/6/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.053
RJL-1	6/9/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.059
RJL-1	6/9/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.059
RJL-1	7/14/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.077
RJL-1	7/14/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.077
RJL-1	8/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.069
RJL-1	8/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.069
RJL-1	10/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.056
RJL-1	10/25/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.056
RJL-1	4/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.112
RJL-1	4/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.112
RJL-1	6/12/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.145
RJL-1	6/12/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.145
RJL-1	7/17/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.147
RJL-1	7/17/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.147
RJL-1	8/14/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.192
RJL-1	8/14/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.192
RJL-1	10/16/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.167
RJL-1	10/16/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.167
RJL-1	1/17/1990	1	Total Phosphorus, mg/L	0.15
RJL-1	2/14/1990	1	Total Phosphorus, mg/L	0.11
RJL-1	3/21/1990	1	Total Phosphorus, mg/L	0.14
RJL-1	4/23/1990	1	Total Phosphorus, mg/L	0.13
RJL-1	5/16/1990	1	Total Phosphorus, mg/L	0.12
RJL-1	5/24/1990	1	Total Phosphorus, mg/L	0.16
RJL-1	5/30/1990	1	Total Phosphorus, mg/L	0.18
RJL-1	6/7/1990	1	Total Phosphorus, mg/L	0.15
RJL-1	6/30/1990	1	Total Phosphorus, mg/L	0.18
RJL-1	7/9/1990	1	Total Phosphorus, mg/L	0.16
RJL-1	7/16/1990	1	Total Phosphorus, mg/L	0.04
RJL-1	8/13/1990	1	Total Phosphorus, mg/L	0.15
RJL-1	9/19/1990	1	Total Phosphorus, mg/L	0.22
RJL-1	10/9/1990	1	Total Phosphorus, mg/L	0.14
RJL-1	11/7/1990	1	Total Phosphorus, mg/L	0.08
RJL-1	12/11/1990	1	Total Phosphorus, mg/L	0.08
RJL-1	2/21/1991	1	Total Phosphorus, mg/L	0.10
RJL-1	3/19/1991	1	Total Phosphorus, mg/L	0.09
RJL-1	4/17/1991	1	Total Phosphorus, mg/L	0.08
RJL-1	5/14/1991	1	Total Phosphorus, mg/L	0.10
RJL-1	6/13/1991	1	Total Phosphorus, mg/L	0.13
RJL-1	7/11/1991	1	Total Phosphorus, mg/L	0.16
RJL-1	8/22/1991	1	Total Phosphorus, mg/L	0.17
RJL-1	9/4/1991	1	Total Phosphorus, mg/L	0.28
RJL-1	9/4/1991	1	Total Phosphorus, mg/L	0.16
RJL-1	9/4/1991	1	Total Phosphorus, mg/L	0.44
RJL-1	9/4/1991	1	Total Phosphorus, mg/L	0.16

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Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJL-1	9/4/1991	1	Total Phosphorus, mg/L	0.16
RJL-1	9/4/1991	1	Total Phosphorus, mg/L	0.22
RJL-1	9/18/1991	1	Total Phosphorus, mg/L	0.19
RJL-1	9/18/1991	1	Total Phosphorus, mg/L	0.14
RJL-1	9/18/1991	1	Total Phosphorus, mg/L	0.14
RJL-1	9/18/1991	1	Total Phosphorus, mg/L	0.14
RJL-1	9/18/1991	1	Total Phosphorus, mg/L	0.15
RJL-1	9/18/1991	1	Total Phosphorus, mg/L	0.14
RJL-1	9/20/1991	1	Total Phosphorus, mg/L	0.32
RJL-1	10/22/1991	1	Total Phosphorus, mg/L	0.16
RJL-1	11/19/1991	1	Total Phosphorus, mg/L	0.08
RJL-1	12/12/1991	1	Total Phosphorus, mg/L	0.08
RJL-1	4/9/1992	1	Total Phosphorus, mg/L	0.11
RJL-1	6/22/1992	1	Total Phosphorus, mg/L	0.14
RJL-1	7/15/1992	1	Total Phosphorus, mg/L	0.14
RJL-1	7/15/1992	1	Total Phosphorus, mg/L	0.15
RJL-1	7/15/1992	1	Total Phosphorus, mg/L	0.13
RJL-1	7/20/1992	1	Total Phosphorus, mg/L	0.16
RJL-1	8/17/1992	1	Total Phosphorus, mg/L	0.20
RJL-1	10/19/1992	1	Total Phosphorus, mg/L	0.16
RJL-1	5/8/1996	1	Total Phosphorus, mg/L	0.15
RJL-1	6/26/1996	1	Total Phosphorus, mg/L	0.11
RJL-1	7/26/1996	1	Total Phosphorus, mg/L	0.18
RJL-1	8/30/1996	1	Total Phosphorus, mg/L	0.18
RJL-1	10/8/1996	1	Total Phosphorus, mg/L	0.16
RJL-1	5/6/1999	1	Total Phosphorus, mg/L	0.05
RJL-1	6/9/1999	1	Total Phosphorus, mg/L	0.06
RJL-1	7/14/1999	1	Total Phosphorus, mg/L	0.08
RJL-1	8/25/1999	1	Total Phosphorus, mg/L	0.07
RJL-1	10/25/1999	1	Total Phosphorus, mg/L	0.06
RJL-1	4/23/2002	1	Total Phosphorus, mg/L	0.11
RJL-1	6/12/2002	1	Total Phosphorus, mg/L	0.15
RJL-1	7/17/2002	1	Total Phosphorus, mg/L	0.15
RJL-1	8/14/2002	1	Total Phosphorus, mg/L	0.19
RJL-1	10/16/2002	1	Total Phosphorus, mg/L	0.17
RJM-1	1/17/1990	1	Dissolved Oxygen, mg/L	13.4
RJM-1	2/14/1990	1	Dissolved Oxygen, mg/L	11.8
RJM-1	3/21/1990	1	Dissolved Oxygen, mg/L	10.8
RJM-1	4/23/1990	1	Dissolved Oxygen, mg/L	13.8
RJM-1	5/24/1990	1	Dissolved Oxygen, mg/L	7.7
RJM-1	6/7/1990	1	Dissolved Oxygen, mg/L	9.3
RJM-1	7/9/1990	1	Dissolved Oxygen, mg/L	12.4
RJM-1	8/13/1990	1	Dissolved Oxygen, mg/L	6.9
RJM-1	9/19/1990	1	Dissolved Oxygen, mg/L	6.0
RJM-1	10/9/1990	1	Dissolved Oxygen, mg/L	5.3
RJM-1	11/7/1990	1	Dissolved Oxygen, mg/L	9.1
RJM-1	12/11/1990	1	Dissolved Oxygen, mg/L	12.0
RJM-1	2/21/1991	1	Dissolved Oxygen, mg/L	16.6
RJM-1	3/19/1991	1	Dissolved Oxygen, mg/L	12.4
RJM-1	4/17/1991	1	Dissolved Oxygen, mg/L	11.3
RJM-1	5/14/1991	1	Dissolved Oxygen, mg/L	14.0

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Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJM-1	6/13/1991	1	Dissolved Oxygen, mg/L	11.5
RJM-1	7/11/1991	1	Dissolved Oxygen, mg/L	7.1
RJM-1	8/22/1991	1	Dissolved Oxygen, mg/L	11.0
RJM-1	9/20/1991	1	Dissolved Oxygen, mg/L	6.3
RJM-1	10/22/1991	1	Dissolved Oxygen, mg/L	8.7
RJM-1	11/19/1991	1	Dissolved Oxygen, mg/L	10.5
RJM-1	12/12/1991	1	Dissolved Oxygen, mg/L	14.3
RJM-1	4/9/1992	1	Dissolved Oxygen, mg/L	13.2
RJM-1	6/22/1992	1	Dissolved Oxygen, mg/L	10.7
RJM-1	7/20/1992	1	Dissolved Oxygen, mg/L	10.8
RJM-1	8/17/1992	1	Dissolved Oxygen, mg/L	11.6
RJM-1	10/19/1992	1	Dissolved Oxygen, mg/L	7.5
RJM-1	5/8/1996	1	Dissolved Oxygen, mg/L	10.6
RJM-1	6/26/1996	1	Dissolved Oxygen, mg/L	7.6
RJM-1	7/26/1996	1	Dissolved Oxygen, mg/L	5.2
RJM-1	8/30/1996	1	Dissolved Oxygen, mg/L	7.5
RJM-1	10/8/1996	1	Dissolved Oxygen, mg/L	6.7
RJM-1	5/6/1999	1	Dissolved Oxygen, mg/L	8.4
RJM-1	5/6/1999	1	Dissolved Oxygen, mg/L	9.6
RJM-1	6/9/1999	1	Dissolved Oxygen, mg/L	12.6
RJM-1	7/14/1999	1	Dissolved Oxygen, mg/L	9.6
RJM-1	8/25/1999	1	Dissolved Oxygen, mg/L	4.3
RJM-1	10/25/1999	1	Dissolved Oxygen, mg/L	9.2
RJM-1	4/23/2002	1	Dissolved Oxygen, mg/L	8.9
RJM-1	6/12/2002	1	Dissolved Oxygen, mg/L	7.9
RJM-1	7/17/2002	1	Dissolved Oxygen, mg/L	10.1
RJM-1	8/14/2002	1	Dissolved Oxygen, mg/L	4.9
RJM-1	10/16/2002	1	Dissolved Oxygen, mg/L	8.4
RJM-1	1/17/1990	1	Total Phosphorus, mg/L	0.16
RJM-1	2/14/1990	1	Total Phosphorus, mg/L	0.11
RJM-1	3/21/1990	1	Total Phosphorus, mg/L	0.08
RJM-1	4/23/1990	1	Total Phosphorus, mg/L	0.08
RJM-1	5/24/1990	1	Total Phosphorus, mg/L	0.24
RJM-1	5/30/1990	1	Total Phosphorus, mg/L	0.24
RJM-1	6/7/1990	1	Total Phosphorus, mg/L	0.21
RJM-1	6/30/1990	1	Total Phosphorus, mg/L	0.09
RJM-1	7/9/1990	1	Total Phosphorus, mg/L	0.15
RJM-1	7/16/1990	1	Total Phosphorus, mg/L	0.21
RJM-1	8/13/1990	1	Total Phosphorus, mg/L	0.09
RJM-1	9/19/1990	1	Total Phosphorus, mg/L	0.13
RJM-1	10/9/1990	1	Total Phosphorus, mg/L	0.10
RJM-1	11/5/1990	1	Total Phosphorus, mg/L	0.59
RJM-1	11/5/1990	1	Total Phosphorus, mg/L	0.06
RJM-1	11/5/1990	1	Total Phosphorus, mg/L	0.06
RJM-1	11/5/1990	1	Total Phosphorus, mg/L	0.11
RJM-1	11/7/1990	1	Total Phosphorus, mg/L	0.12
RJM-1	11/27/1990	1	Total Phosphorus, mg/L	0.10
RJM-1	11/27/1990	1	Total Phosphorus, mg/L	0.11
RJM-1	11/27/1990	1	Total Phosphorus, mg/L	0.23
RJM-1	11/27/1990	1	Total Phosphorus, mg/L	0.13
RJM-1	11/28/1990	1	Total Phosphorus, mg/L	0.12

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Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJM-1	11/28/1990	1	Total Phosphorus, mg/L	0.12
RJM-1	11/28/1990	1	Total Phosphorus, mg/L	0.13
RJM-1	12/11/1990	1	Total Phosphorus, mg/L	0.14
RJM-1	12/17/1990	1	Total Phosphorus, mg/L	0.11
RJM-1	12/17/1990	1	Total Phosphorus, mg/L	0.10
RJM-1	12/17/1990	1	Total Phosphorus, mg/L	0.13
RJM-1	12/18/1990	1	Total Phosphorus, mg/L	0.15
RJM-1	12/18/1990	1	Total Phosphorus, mg/L	0.13
RJM-1	12/18/1990	1	Total Phosphorus, mg/L	0.13
RJM-1	2/21/1991	1	Total Phosphorus, mg/L	0.11
RJM-1	3/19/1991	1	Total Phosphorus, mg/L	0.14
RJM-1	3/19/1991	1	Total Phosphorus, mg/L	0.13
RJM-1	3/19/1991	1	Total Phosphorus, mg/L	0.11
RJM-1	3/19/1991	1	Total Phosphorus, mg/L	0.11
RJM-1	4/17/1991	1	Total Phosphorus, mg/L	0.20
RJM-1	5/14/1991	1	Total Phosphorus, mg/L	0.31
RJM-1	6/13/1991	1	Total Phosphorus, mg/L	0.19
RJM-1	7/10/1991	1	Total Phosphorus, mg/L	0.25
RJM-1	7/10/1991	1	Total Phosphorus, mg/L	0.16
RJM-1	7/11/1991	1	Total Phosphorus, mg/L	0.16
RJM-1	7/11/1991	1	Total Phosphorus, mg/L	0.21
RJM-1	7/11/1991	1	Total Phosphorus, mg/L	0.26
RJM-1	7/11/1991	1	Total Phosphorus, mg/L	0.28
RJM-1	8/22/1991	1	Total Phosphorus, mg/L	0.17
RJM-1	9/20/1991	1	Total Phosphorus, mg/L	0.13
RJM-1	10/22/1991	1	Total Phosphorus, mg/L	0.13
RJM-1	10/22/1991	1	Total Phosphorus, mg/L	0.12
RJM-1	11/3/1991	1	Total Phosphorus, mg/L	0.45
RJM-1	11/3/1991	1	Total Phosphorus, mg/L	0.13
RJM-1	11/3/1991	1	Total Phosphorus, mg/L	0.10
RJM-1	11/19/1991	1	Total Phosphorus, mg/L	0.16
RJM-1	12/12/1991	1	Total Phosphorus, mg/L	0.10
RJM-1	12/12/1991	1	Total Phosphorus, mg/L	0.11
RJM-1	12/26/1991	1	Total Phosphorus, mg/L	0.09
RJM-1	1/29/1992	1	Total Phosphorus, mg/L	0.06
RJM-1	2/27/1992	1	Total Phosphorus, mg/L	0.10
RJM-1	3/11/1992	1	Total Phosphorus, mg/L	0.13
RJM-1	3/30/1992	1	Total Phosphorus, mg/L	0.35
RJM-1	3/30/1992	1	Total Phosphorus, mg/L	0.25
RJM-1	3/30/1992	1	Total Phosphorus, mg/L	0.19
RJM-1	4/1/1992	1	Total Phosphorus, mg/L	0.09
RJM-1	4/9/1992	1	Total Phosphorus, mg/L	0.17
RJM-1	4/9/1992	1	Total Phosphorus, mg/L	0.09
RJM-1	4/21/1992	1	Total Phosphorus, mg/L	0.13
RJM-1	5/5/1992	1	Total Phosphorus, mg/L	0.14
RJM-1	5/15/1992	1	Total Phosphorus, mg/L	0.10
RJM-1	5/28/1992	1	Total Phosphorus, mg/L	0.13
RJM-1	6/8/1992	1	Total Phosphorus, mg/L	0.11
RJM-1	6/22/1992	1	Total Phosphorus, mg/L	0.12
RJM-1	7/20/1992	1	Total Phosphorus, mg/L	0.16
RJM-1	8/17/1992	1	Total Phosphorus, mg/L	0.11

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Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJM-1	8/28/1992	1	Total Phosphorus, mg/L	0.50
RJM-1	10/19/1992	1	Total Phosphorus, mg/L	0.10
RJM-1	5/8/1996	1	Total Phosphorus, mg/L	0.22
RJM-1	6/26/1996	1	Total Phosphorus, mg/L	0.15
RJM-1	7/26/1996	1	Total Phosphorus, mg/L	0.12
RJM-1	8/30/1996	1	Total Phosphorus, mg/L	0.13
RJM-1	10/8/1996	1	Total Phosphorus, mg/L	0.15
RJM-1	5/6/1999	1	Total Phosphorus, mg/L	0.08
RJM-1	6/9/1999	1	Total Phosphorus, mg/L	0.10
RJM-1	7/14/1999	1	Total Phosphorus, mg/L	0.10
RJM-1	8/25/1999	1	Total Phosphorus, mg/L	0.16
RJM-1	10/25/1999	1	Total Phosphorus, mg/L	0.09
RJM-1	4/23/2002	1	Total Phosphorus, mg/L	0.14
RJM-1	6/12/2002	1	Total Phosphorus, mg/L	0.16
RJM-1	7/17/2002	1	Total Phosphorus, mg/L	0.24
RJM-1	8/14/2002	1	Total Phosphorus, mg/L	0.32
RJM-1	10/16/2002	1	Total Phosphorus, mg/L	0.21
RJM-2	1/17/1990	1	Dissolved Oxygen, mg/L	13.3
RJM-2	2/14/1990	1	Dissolved Oxygen, mg/L	12.0
RJM-2	3/21/1990	1	Dissolved Oxygen, mg/L	10.5
RJM-2	4/23/1990	1	Dissolved Oxygen, mg/L	13.4
RJM-2	5/24/1990	1	Dissolved Oxygen, mg/L	5.3
RJM-2	6/7/1990	1	Dissolved Oxygen, mg/L	10.0
RJM-2	7/9/1990	1	Dissolved Oxygen, mg/L	14.2
RJM-2	8/13/1990	1	Dissolved Oxygen, mg/L	8.6
RJM-2	9/19/1990	1	Dissolved Oxygen, mg/L	5.8
RJM-2	10/9/1990	1	Dissolved Oxygen, mg/L	5.7
RJM-2	11/7/1990	1	Dissolved Oxygen, mg/L	8.4
RJM-2	12/11/1990	1	Dissolved Oxygen, mg/L	12.3
RJM-2	2/21/1991	1	Dissolved Oxygen, mg/L	16.7
RJM-2	3/19/1991	1	Dissolved Oxygen, mg/L	12.6
RJM-2	4/17/1991	1	Dissolved Oxygen, mg/L	12.5
RJM-2	5/14/1991	1	Dissolved Oxygen, mg/L	11.6
RJM-2	6/13/1991	1	Dissolved Oxygen, mg/L	10.0
RJM-2	7/11/1991	1	Dissolved Oxygen, mg/L	8.2
RJM-2	8/22/1991	1	Dissolved Oxygen, mg/L	10.2
RJM-2	9/20/1991	1	Dissolved Oxygen, mg/L	7.4
RJM-2	10/22/1991	1	Dissolved Oxygen, mg/L	8.0
RJM-2	11/19/1991	1	Dissolved Oxygen, mg/L	9.8
RJM-2	12/12/1991	1	Dissolved Oxygen, mg/L	13.6
RJM-2	4/9/1992	1	Dissolved Oxygen, mg/L	13.2
RJM-2	6/22/1992	1	Dissolved Oxygen, mg/L	10.7
RJM-2	7/20/1992	1	Dissolved Oxygen, mg/L	11.0
RJM-2	8/17/1992	1	Dissolved Oxygen, mg/L	11.1
RJM-2	10/19/1992	1	Dissolved Oxygen, mg/L	8.1
RJM-2	5/8/1996	1	Dissolved Oxygen, mg/L	9.2
RJM-2	6/26/1996	1	Dissolved Oxygen, mg/L	5.9
RJM-2	7/26/1996	1	Dissolved Oxygen, mg/L	8.2
RJM-2	8/30/1996	1	Dissolved Oxygen, mg/L	9.6
RJM-2	10/8/1996	1	Dissolved Oxygen, mg/L	8.8
RJM-2	5/6/1999	1	Dissolved Oxygen, mg/L	8.9

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Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJM-2	6/9/1999	1	Dissolved Oxygen, mg/L	10.8
RJM-2	7/14/1999	1	Dissolved Oxygen, mg/L	8.3
RJM-2	8/25/1999	1	Dissolved Oxygen, mg/L	5.9
RJM-2	10/25/1999	1	Dissolved Oxygen, mg/L	9.6
RJM-2	4/23/2002	1	Dissolved Oxygen, mg/L	10.0
RJM-2	6/12/2002	1	Dissolved Oxygen, mg/L	6.2
RJM-2	7/17/2002	1	Dissolved Oxygen, mg/L	10.5
RJM-2	8/14/2002	1	Dissolved Oxygen, mg/L	6.7
RJM-2	10/16/2002	1	Dissolved Oxygen, mg/L	9.2
RJM-2	1/17/1990	1	Total Phosphorus, mg/L	0.20
RJM-2	2/14/1990	1	Total Phosphorus, mg/L	0.11
RJM-2	3/21/1990	1	Total Phosphorus, mg/L	0.09
RJM-2	4/23/1990	1	Total Phosphorus, mg/L	0.10
RJM-2	5/24/1990	1	Total Phosphorus, mg/L	0.28
RJM-2	6/7/1990	1	Total Phosphorus, mg/L	0.22
RJM-2	7/9/1990	1	Total Phosphorus, mg/L	0.16
RJM-2	8/13/1990	1	Total Phosphorus, mg/L	0.09
RJM-2	9/19/1990	1	Total Phosphorus, mg/L	0.14
RJM-2	10/9/1990	1	Total Phosphorus, mg/L	0.15
RJM-2	11/7/1990	1	Total Phosphorus, mg/L	0.12
RJM-2	12/11/1990	1	Total Phosphorus, mg/L	0.15
RJM-2	2/21/1991	1	Total Phosphorus, mg/L	0.10
RJM-2	3/19/1991	1	Total Phosphorus, mg/L	0.09
RJM-2	4/17/1991	1	Total Phosphorus, mg/L	0.16
RJM-2	5/14/1991	1	Total Phosphorus, mg/L	0.13
RJM-2	6/13/1991	1	Total Phosphorus, mg/L	0.15
RJM-2	7/11/1991	1	Total Phosphorus, mg/L	0.26
RJM-2	8/22/1991	1	Total Phosphorus, mg/L	0.16
RJM-2	9/20/1991	1	Total Phosphorus, mg/L	0.15
RJM-2	10/22/1991	1	Total Phosphorus, mg/L	0.13
RJM-2	11/19/1991	1	Total Phosphorus, mg/L	0.17
RJM-2	12/12/1991	1	Total Phosphorus, mg/L	0.10
RJM-2	3/30/1992	1	Total Phosphorus, mg/L	0.10
RJM-2	3/30/1992	1	Total Phosphorus, mg/L	0.10
RJM-2	3/30/1992	1	Total Phosphorus, mg/L	0.10
RJM-2	4/9/1992	1	Total Phosphorus, mg/L	0.09
RJM-2	6/22/1992	1	Total Phosphorus, mg/L	0.11
RJM-2	7/20/1992	1	Total Phosphorus, mg/L	0.15
RJM-2	8/17/1992	1	Total Phosphorus, mg/L	0.13
RJM-2	10/19/1992	1	Total Phosphorus, mg/L	0.09
RJM-2	5/8/1996	1	Total Phosphorus, mg/L	0.21
RJM-2	6/3/1996	1	Total Phosphorus, mg/L	0.18
RJM-2	6/26/1996	1	Total Phosphorus, mg/L	0.18
RJM-2	7/26/1996	1	Total Phosphorus, mg/L	0.16
RJM-2	8/30/1996	1	Total Phosphorus, mg/L	0.14
RJM-2	10/8/1996	1	Total Phosphorus, mg/L	0.18
RJM-2	5/6/1999	1	Total Phosphorus, mg/L	0.07
RJM-2	6/9/1999	1	Total Phosphorus, mg/L	0.10
RJM-2	7/14/1999	1	Total Phosphorus, mg/L	0.12
RJM-2	8/25/1999	1	Total Phosphorus, mg/L	0.17
RJM-2	10/25/1999	1	Total Phosphorus, mg/L	0.09

Water Quality Data
Cahokia Canal/Horseshoe Lake Watershed

Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJM-2	4/23/2002	1	Total Phosphorus, mg/L	0.15
RJM-2	6/12/2002	1	Total Phosphorus, mg/L	0.14
RJM-2	7/17/2002	1	Total Phosphorus, mg/L	0.26
RJM-2	8/14/2002	1	Total Phosphorus, mg/L	0.39
RJM-2	10/16/2002	1	Total Phosphorus, mg/L	0.21
RJM-3	1/17/1990	1	Dissolved Oxygen, mg/L	13.5
RJM-3	2/14/1990	1	Dissolved Oxygen, mg/L	11.8
RJM-3	3/21/1990	1	Dissolved Oxygen, mg/L	10.7
RJM-3	4/23/1990	1	Dissolved Oxygen, mg/L	13.6
RJM-3	5/24/1990	1	Dissolved Oxygen, mg/L	5.3
RJM-3	6/7/1990	1	Dissolved Oxygen, mg/L	9.0
RJM-3	7/9/1990	1	Dissolved Oxygen, mg/L	10.5
RJM-3	8/13/1990	1	Dissolved Oxygen, mg/L	10.9
RJM-3	9/19/1990	1	Dissolved Oxygen, mg/L	6.8
RJM-3	10/9/1990	1	Dissolved Oxygen, mg/L	6.3
RJM-3	11/7/1990	1	Dissolved Oxygen, mg/L	8.6
RJM-3	12/11/1990	1	Dissolved Oxygen, mg/L	12.3
RJM-3	2/21/1991	1	Dissolved Oxygen, mg/L	16.2
RJM-3	3/19/1991	1	Dissolved Oxygen, mg/L	12.1
RJM-3	4/17/1991	1	Dissolved Oxygen, mg/L	14.4
RJM-3	5/14/1991	1	Dissolved Oxygen, mg/L	11.4
RJM-3	6/13/1991	1	Dissolved Oxygen, mg/L	11.6
RJM-3	7/11/1991	1	Dissolved Oxygen, mg/L	9.9
RJM-3	8/22/1991	1	Dissolved Oxygen, mg/L	6.9
RJM-3	9/20/1991	1	Dissolved Oxygen, mg/L	11.0
RJM-3	10/22/1991	1	Dissolved Oxygen, mg/L	7.9
RJM-3	11/19/1991	1	Dissolved Oxygen, mg/L	9.6
RJM-3	12/12/1991	1	Dissolved Oxygen, mg/L	13.6
RJM-3	4/9/1992	1	Dissolved Oxygen, mg/L	12.9
RJM-3	6/22/1992	1	Dissolved Oxygen, mg/L	14.8
RJM-3	7/20/1992	1	Dissolved Oxygen, mg/L	8.4
RJM-3	8/17/1992	1	Dissolved Oxygen, mg/L	12.0
RJM-3	10/19/1992	1	Dissolved Oxygen, mg/L	8.4
RJM-3	5/8/1996	1	Dissolved Oxygen, mg/L	8.4
RJM-3	6/26/1996	1	Dissolved Oxygen, mg/L	9.1
RJM-3	7/26/1996	1	Dissolved Oxygen, mg/L	8.7
RJM-3	8/30/1996	1	Dissolved Oxygen, mg/L	10.2
RJM-3	10/8/1996	1	Dissolved Oxygen, mg/L	9.0
RJM-3	6/9/1999	1	Dissolved Oxygen, mg/L	11.6
RJM-3	7/14/1999	1	Dissolved Oxygen, mg/L	8.6
RJM-3	8/25/1999	1	Dissolved Oxygen, mg/L	9.4
RJM-3	10/25/1999	1	Dissolved Oxygen, mg/L	10.3
RJM-3	4/23/2002	1	Dissolved Oxygen, mg/L	11.0
RJM-3	6/12/2002	1	Dissolved Oxygen, mg/L	7.9
RJM-3	7/17/2002	1	Dissolved Oxygen, mg/L	9.1
RJM-3	8/14/2002	1	Dissolved Oxygen, mg/L	9.9
RJM-3	10/16/2002	1	Dissolved Oxygen, mg/L	10.4
RJM-3	1/17/1990	1	Total Phosphorus, mg/L	0.20
RJM-3	2/14/1990	1	Total Phosphorus, mg/L	0.14
RJM-3	3/21/1990	1	Total Phosphorus, mg/L	0.11
RJM-3	4/23/1990	1	Total Phosphorus, mg/L	0.10

Water Quality Data
Cahokia Canal/Horseshoe Lake Watershed

Station ID	Sampling Date	Sample Depth (ft)	Parameter	Result Value
RJM-3	5/24/1990	1	Total Phosphorus, mg/L	0.28
RJM-3	6/7/1990	1	Total Phosphorus, mg/L	0.19
RJM-3	7/9/1990	1	Total Phosphorus, mg/L	0.12
RJM-3	8/13/1990	1	Total Phosphorus, mg/L	0.15
RJM-3	9/19/1990	1	Total Phosphorus, mg/L	0.15
RJM-3	10/9/1990	1	Total Phosphorus, mg/L	0.27
RJM-3	11/7/1990	1	Total Phosphorus, mg/L	0.16
RJM-3	12/11/1990	1	Total Phosphorus, mg/L	0.18
RJM-3	2/21/1991	1	Total Phosphorus, mg/L	0.13
RJM-3	3/19/1991	1	Total Phosphorus, mg/L	0.13
RJM-3	4/17/1991	1	Total Phosphorus, mg/L	0.17
RJM-3	5/14/1991	1	Total Phosphorus, mg/L	0.14
RJM-3	6/13/1991	1	Total Phosphorus, mg/L	0.16
RJM-3	7/10/1991	1	Total Phosphorus, mg/L	0.28
RJM-3	7/10/1991	1	Total Phosphorus, mg/L	0.28
RJM-3	7/10/1991	1	Total Phosphorus, mg/L	0.27
RJM-3	7/11/1991	1	Total Phosphorus, mg/L	0.28
RJM-3	7/11/1991	1	Total Phosphorus, mg/L	0.28
RJM-3	7/11/1991	1	Total Phosphorus, mg/L	0.26
RJM-3	7/11/1991	1	Total Phosphorus, mg/L	0.28
RJM-3	8/22/1991	1	Total Phosphorus, mg/L	0.23
RJM-3	9/20/1991	1	Total Phosphorus, mg/L	0.22
RJM-3	10/22/1991	1	Total Phosphorus, mg/L	0.14
RJM-3	11/3/1991	1	Total Phosphorus, mg/L	0.13
RJM-3	11/19/1991	1	Total Phosphorus, mg/L	0.19
RJM-3	11/20/1991	1	Total Phosphorus, mg/L	0.17
RJM-3	11/20/1991	1	Total Phosphorus, mg/L	0.17
RJM-3	11/20/1991	1	Total Phosphorus, mg/L	0.16
RJM-3	12/3/1991	1	Total Phosphorus, mg/L	0.13
RJM-3	12/3/1991	1	Total Phosphorus, mg/L	0.12
RJM-3	12/12/1991	1	Total Phosphorus, mg/L	0.10
RJM-3	4/9/1992	1	Total Phosphorus, mg/L	0.10
RJM-3	6/22/1992	1	Total Phosphorus, mg/L	0.23
RJM-3	7/20/1992	1	Total Phosphorus, mg/L	0.19
RJM-3	8/17/1992	1	Total Phosphorus, mg/L	0.20
RJM-3	10/19/1992	1	Total Phosphorus, mg/L	0.10
RJM-3	5/8/1996	1	Total Phosphorus, mg/L	0.16
RJM-3	6/26/1996	1	Total Phosphorus, mg/L	0.36
RJM-3	7/26/1996	1	Total Phosphorus, mg/L	0.23
RJM-3	8/30/1996	1	Total Phosphorus, mg/L	0.19
RJM-3	10/8/1996	1	Total Phosphorus, mg/L	0.18
RJM-3	5/6/1999	1	Total Phosphorus, mg/L	0.10
RJM-3	6/9/1999	1	Total Phosphorus, mg/L	0.10
RJM-3	7/14/1999	1	Total Phosphorus, mg/L	0.16
RJM-3	8/25/1999	1	Total Phosphorus, mg/L	0.16
RJM-3	10/25/1999	1	Total Phosphorus, mg/L	0.11
RJM-3	4/23/2002	1	Total Phosphorus, mg/L	0.14
RJM-3	6/12/2002	1	Total Phosphorus, mg/L	0.27
RJM-3	7/17/2002	1	Total Phosphorus, mg/L	0.27
RJM-3	8/14/2002	1	Total Phosphorus, mg/L	0.36
RJM-3	10/16/2002	1	Total Phosphorus, mg/L	0.26

Continuous Dissolved Oxygen Data
Cahokia Canal/Horseshoe Lake Watershed

Log File Name	Sampling Date	Sampling Time	Sample Depth (ft)	Parameter	Result Value
JMAA-02-PO	7/25/2005	12:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.38
JMAA-02-PO	7/25/2005	12:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.69
JMAA-02-PO	7/25/2005	13:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.98
JMAA-02-PO	7/25/2005	13:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.23
JMAA-02-PO	7/25/2005	14:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.44
JMAA-02-PO	7/25/2005	14:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.58
JMAA-02-PO	7/25/2005	15:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.62
JMAA-02-PO	7/25/2005	15:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.59
JMAA-02-PO	7/25/2005	16:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.59
JMAA-02-PO	7/25/2005	16:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.52
JMAA-02-PO	7/25/2005	17:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.49
JMAA-02-PO	7/25/2005	17:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.42
JMAA-02-PO	7/25/2005	18:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.38
JMAA-02-PO	7/25/2005	18:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.24
JMAA-02-PO	7/25/2005	19:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.09
JMAA-02-PO	7/25/2005	19:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.87
JMAA-02-PO	7/25/2005	20:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.64
JMAA-02-PO	7/25/2005	20:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.49
JMAA-02-PO	7/25/2005	21:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.34
JMAA-02-PO	7/25/2005	21:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.15
JMAA-02-PO	7/25/2005	22:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6
JMAA-02-PO	7/25/2005	22:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.82
JMAA-02-PO	7/25/2005	23:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.69
JMAA-02-PO	7/25/2005	23:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.62
JMAA-02-PO	7/26/2005	0:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.52
JMAA-02-PO	7/26/2005	0:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.51
JMAA-02-PO	7/26/2005	1:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.37
JMAA-02-PO	7/26/2005	1:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.32
JMAA-02-PO	7/26/2005	2:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.25
JMAA-02-PO	7/26/2005	2:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.23
JMAA-02-PO	7/26/2005	3:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.18
JMAA-02-PO	7/26/2005	3:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.24
JMAA-02-PO	7/26/2005	4:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.17
JMAA-02-PO	7/26/2005	4:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.16
JMAA-02-PO	7/26/2005	5:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.13
JMAA-02-PO	7/26/2005	5:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.14
JMAA-02-PO	7/26/2005	6:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.16
JMAA-02-PO	7/26/2005	6:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.2
JMAA-02-PO	7/26/2005	7:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.23
JMAA-02-PO	7/26/2005	7:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.3
JMAA-02-PO	7/26/2005	8:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.3
JMAA-02-PO	7/26/2005	8:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.36
JMAA-02-PO	7/26/2005	9:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.4
JMAA-02-PO	7/26/2005	9:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.47
JMAA-02-PO	7/26/2005	10:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.57
JMAA-02-PO	7/26/2005	10:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.73
JMAA-02-PO	7/26/2005	11:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.94
JMAA-02-PO	7/26/2005	11:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.23
JMAA-02-PO	7/26/2005	12:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.51
JMAA-02-PO	7/26/2005	12:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.78
JMAA-02-PO	7/26/2005	13:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.06
JMAA-02-PO	7/26/2005	13:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.4
JMAA-02-PO	7/26/2005	14:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.67
JMAA-02-PO	7/26/2005	14:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.77

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JMAA-02-PO	7/26/2005	15:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.87
JMAA-02-PO	7/26/2005	15:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.87
JMAA-02-PO	7/26/2005	16:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.81
JMAA-02-PO	7/26/2005	16:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.71
JMAA-02-PO	7/26/2005	17:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.65
JMAA-02-PO	7/26/2005	17:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.67
JMAA-02-PO	7/26/2005	18:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.47
JMAA-02-PO	7/26/2005	18:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.4
JMAA-02-PO	7/26/2005	19:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.23
JMAA-02-PO	7/26/2005	19:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.08
JMAA-02-PO	7/26/2005	20:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.88
JMAA-02-PO	7/26/2005	20:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.7
JMAA-02-PO	7/26/2005	21:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.47
JMAA-02-PO	7/26/2005	21:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.25
JMAA-02-PO	7/26/2005	22:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.14
JMAA-02-PO	7/26/2005	22:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.94
JMAA-02-PO	7/26/2005	23:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.9
JMAA-02-PO	7/26/2005	23:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.82
JMAA-02-PO	7/27/2005	0:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.78
JMAA-02-PO	7/27/2005	0:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.69
JMAA-02-PO	7/27/2005	1:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.68
JMAA-02-PO	7/27/2005	1:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.7
JMAA-02-PO	7/27/2005	2:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.71
JMAA-02-PO	7/27/2005	2:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.72
JMAA-02-PO	7/27/2005	3:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.73
JMAA-02-PO	7/27/2005	3:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.75
JMAA-02-PO	7/27/2005	4:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.77
JMAA-02-PO	7/27/2005	4:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.77
JMAA-02-PO	7/27/2005	5:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.75
JMAA-02-PO	7/27/2005	5:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.74
JMAA-02-PO	7/27/2005	6:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.79
JMAA-02-PO	7/27/2005	6:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.73
JMAA-02-PO	7/27/2005	7:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.78
JMAA-02-PO	7/27/2005	7:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.77
JMAA-02-PO	7/27/2005	8:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.71
JMAA-02-PO	7/27/2005	8:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.75
JMAA-02-PO	7/27/2005	9:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.78
JMAA-02-PO	7/27/2005	9:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.9
JMAA-02-PO	7/27/2005	10:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.96
JMAA-02-PO	7/27/2005	10:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.06
JMAA-02-PO	7/27/2005	11:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.27
JMAA-02-PO	7/27/2005	11:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.53
JMAA-02-PO	7/27/2005	12:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.72
JMAA-02-PO	7/27/2005	12:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.14
JMAA-02-PO	7/27/2005	13:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.35
JMAA-02-PO	7/27/2005	13:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.64
JMAA-02-PO	7/27/2005	14:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.76
JMAA-02-PO	7/27/2005	14:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.87
JMAA-02-PO	7/27/2005	15:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.04
JMAA-02-PO	7/27/2005	15:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.13
JMAA-02-PO	7/27/2005	16:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.2
JMAA-02-PO	7/27/2005	16:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.13
JMAA-02-PO	7/27/2005	17:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.11
JMAA-02-PO	7/27/2005	17:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.06
JMAA-02-PO	7/27/2005	18:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.86

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Cahokia Canal/Horseshoe Lake Watershed

JMAA-02-PO	7/27/2005	18:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.7
JMAA-02-PO	7/27/2005	19:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.49
JMAA-02-PO	7/27/2005	19:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.23
JMAA-02-PO	7/27/2005	20:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.04
JMAA-02-PO	7/27/2005	20:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.89
JMAA-02-PO	7/27/2005	21:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.75
JMAA-02-PO	7/27/2005	21:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.59
JMAA-02-PO	7/27/2005	22:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.53
JMAA-02-PO	7/27/2005	22:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.41
JMAA-02-PO	7/27/2005	23:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.34
JMAA-02-PO	7/27/2005	23:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.26
JMAA-02-PO	7/28/2005	0:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.22
JMAA-02-PO	7/28/2005	0:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.19
JMAA-02-PO	7/28/2005	1:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.15
JMAA-02-PO	7/28/2005	1:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.12
JMAA-02-PO	7/28/2005	2:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.18
JMAA-02-PO	7/28/2005	2:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.17
JMAA-02-PO	7/28/2005	3:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.2
JMAA-02-PO	7/28/2005	3:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.2
JMAA-02-PO	7/28/2005	4:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.19
JMAA-02-PO	7/28/2005	4:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.19
JMAA-02-PO	7/28/2005	5:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.24
JMAA-02-PO	7/28/2005	5:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.29
JMAA-02-PO	7/28/2005	6:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.3
JMAA-02-PO	7/28/2005	6:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.31
JMAA-02-PO	7/28/2005	7:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.33
JMAA-02-PO	7/28/2005	7:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.37
JMAA-02-PO	7/28/2005	8:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.4
JMAA-02-PO	7/28/2005	8:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.37
JMAA-02-PO	7/28/2005	9:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.44
JMAA-02-PO	7/28/2005	9:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.47
JMAA-02-PO	7/28/2005	10:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.55
JMAA-02-PO	7/28/2005	10:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.78
JMAA-02-PO	7/28/2005	11:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.96
JMAA-02-PO	7/28/2005	11:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.23
JMAA-02-PO	7/28/2005	12:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.56
JMAA-02-RU	7/25/2005	12:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.51
JMAA-02-RU	7/25/2005	12:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.77
JMAA-02-RU	7/25/2005	13:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7
JMAA-02-RU	7/25/2005	13:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.21
JMAA-02-RU	7/25/2005	14:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.45
JMAA-02-RU	7/25/2005	14:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.53
JMAA-02-RU	7/25/2005	15:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.6
JMAA-02-RU	7/25/2005	15:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.58
JMAA-02-RU	7/25/2005	16:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.5
JMAA-02-RU	7/25/2005	16:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.46
JMAA-02-RU	7/25/2005	17:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.43
JMAA-02-RU	7/25/2005	17:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.35
JMAA-02-RU	7/25/2005	18:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.31
JMAA-02-RU	7/25/2005	18:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.2
JMAA-02-RU	7/25/2005	19:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.06
JMAA-02-RU	7/25/2005	19:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.9
JMAA-02-RU	7/25/2005	20:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.69
JMAA-02-RU	7/25/2005	20:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.45
JMAA-02-RU	7/25/2005	21:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.28

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JMAA-02-RU	7/25/2005	21:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.13
JMAA-02-RU	7/25/2005	22:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.01
JMAA-02-RU	7/25/2005	22:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.87
JMAA-02-RU	7/25/2005	23:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.72
JMAA-02-RU	7/25/2005	23:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.69
JMAA-02-RU	7/26/2005	0:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.57
JMAA-02-RU	7/26/2005	0:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.52
JMAA-02-RU	7/26/2005	1:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.46
JMAA-02-RU	7/26/2005	1:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.37
JMAA-02-RU	7/26/2005	2:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.36
JMAA-02-RU	7/26/2005	2:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.33
JMAA-02-RU	7/26/2005	3:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.27
JMAA-02-RU	7/26/2005	3:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.31
JMAA-02-RU	7/26/2005	4:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.23
JMAA-02-RU	7/26/2005	4:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.27
JMAA-02-RU	7/26/2005	5:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.22
JMAA-02-RU	7/26/2005	5:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.23
JMAA-02-RU	7/26/2005	6:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.29
JMAA-02-RU	7/26/2005	6:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.28
JMAA-02-RU	7/26/2005	7:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.29
JMAA-02-RU	7/26/2005	7:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.34
JMAA-02-RU	7/26/2005	8:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.38
JMAA-02-RU	7/26/2005	8:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.44
JMAA-02-RU	7/26/2005	9:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.5
JMAA-02-RU	7/26/2005	9:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.62
JMAA-02-RU	7/26/2005	10:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.69
JMAA-02-RU	7/26/2005	10:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.9
JMAA-02-RU	7/26/2005	11:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.09
JMAA-02-RU	7/26/2005	11:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.34
JMAA-02-RU	7/26/2005	12:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.66
JMAA-02-RU	7/26/2005	12:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.91
JMAA-02-RU	7/26/2005	13:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.23
JMAA-02-RU	7/26/2005	13:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.5
JMAA-02-RU	7/26/2005	14:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.77
JMAA-02-RU	7/26/2005	14:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.89
JMAA-02-RU	7/26/2005	15:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.93
JMAA-02-RU	7/26/2005	15:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.89
JMAA-02-RU	7/26/2005	16:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.8
JMAA-02-RU	7/26/2005	16:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.78
JMAA-02-RU	7/26/2005	17:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.71
JMAA-02-RU	7/26/2005	17:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.69
JMAA-02-RU	7/26/2005	18:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.54
JMAA-02-RU	7/26/2005	18:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.5
JMAA-02-RU	7/26/2005	19:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.33
JMAA-02-RU	7/26/2005	19:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.16
JMAA-02-RU	7/26/2005	20:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.94
JMAA-02-RU	7/26/2005	20:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.73
JMAA-02-RU	7/26/2005	21:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.55
JMAA-02-RU	7/26/2005	21:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.37
JMAA-02-RU	7/26/2005	22:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.21
JMAA-02-RU	7/26/2005	22:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.06
JMAA-02-RU	7/26/2005	23:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.95
JMAA-02-RU	7/26/2005	23:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.89
JMAA-02-RU	7/27/2005	0:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.85
JMAA-02-RU	7/27/2005	0:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.79

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JMAA-02-RU	7/27/2005	1:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.82
JMAA-02-RU	7/27/2005	1:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.78
JMAA-02-RU	7/27/2005	2:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.8
JMAA-02-RU	7/27/2005	2:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.82
JMAA-02-RU	7/27/2005	3:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.8
JMAA-02-RU	7/27/2005	3:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.89
JMAA-02-RU	7/27/2005	4:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.86
JMAA-02-RU	7/27/2005	4:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.9
JMAA-02-RU	7/27/2005	5:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.88
JMAA-02-RU	7/27/2005	5:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.86
JMAA-02-RU	7/27/2005	6:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.83
JMAA-02-RU	7/27/2005	6:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.87
JMAA-02-RU	7/27/2005	7:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.81
JMAA-02-RU	7/27/2005	7:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.83
JMAA-02-RU	7/27/2005	8:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.85
JMAA-02-RU	7/27/2005	8:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.85
JMAA-02-RU	7/27/2005	9:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.92
JMAA-02-RU	7/27/2005	9:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.98
JMAA-02-RU	7/27/2005	10:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.01
JMAA-02-RU	7/27/2005	10:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.2
JMAA-02-RU	7/27/2005	11:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.34
JMAA-02-RU	7/27/2005	11:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.65
JMAA-02-RU	7/27/2005	12:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.8
JMAA-02-RU	7/27/2005	12:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.24
JMAA-02-RU	7/27/2005	13:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.47
JMAA-02-RU	7/27/2005	13:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.77
JMAA-02-RU	7/27/2005	14:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.85
JMAA-02-RU	7/27/2005	14:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.01
JMAA-02-RU	7/27/2005	15:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.16
JMAA-02-RU	7/27/2005	15:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.24
JMAA-02-RU	7/27/2005	16:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.33
JMAA-02-RU	7/27/2005	16:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.29
JMAA-02-RU	7/27/2005	17:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.19
JMAA-02-RU	7/27/2005	17:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.11
JMAA-02-RU	7/27/2005	18:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.02
JMAA-02-RU	7/27/2005	18:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.82
JMAA-02-RU	7/27/2005	19:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.52
JMAA-02-RU	7/27/2005	19:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.31
JMAA-02-RU	7/27/2005	20:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.13
JMAA-02-RU	7/27/2005	20:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.92
JMAA-02-RU	7/27/2005	21:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.79
JMAA-02-RU	7/27/2005	21:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.68
JMAA-02-RU	7/27/2005	22:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.57
JMAA-02-RU	7/27/2005	22:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.5
JMAA-02-RU	7/27/2005	23:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.46
JMAA-02-RU	7/27/2005	23:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.41
JMAA-02-RU	7/28/2005	0:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.38
JMAA-02-RU	7/28/2005	0:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.32
JMAA-02-RU	7/28/2005	1:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.3
JMAA-02-RU	7/28/2005	1:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.21
JMAA-02-RU	7/28/2005	2:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.22
JMAA-02-RU	7/28/2005	2:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.25
JMAA-02-RU	7/28/2005	3:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.23
JMAA-02-RU	7/28/2005	3:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.34
JMAA-02-RU	7/28/2005	4:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.33

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JMAA-02-RU	7/28/2005	4:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.31
JMAA-02-RU	7/28/2005	5:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.38
JMAA-02-RU	7/28/2005	5:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.4
JMAA-02-RU	7/28/2005	6:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.44
JMAA-02-RU	7/28/2005	6:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.36
JMAA-02-RU	7/28/2005	7:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.41
JMAA-02-RU	7/28/2005	7:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.37
JMAA-02-RU	7/28/2005	8:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.45
JMAA-02-RU	7/28/2005	8:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.48
JMAA-02-RU	7/28/2005	9:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.52
JMAA-02-RU	7/28/2005	9:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.56
JMAA-02-RU	7/28/2005	10:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.63
JMAA-02-RU	7/28/2005	10:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.8
JMAA-02-RU	7/28/2005	11:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.09
JMAA-02-RU	7/28/2005	11:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.35
JMAA-02-RU	7/28/2005	12:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.66
JMAA-02-RI	7/25/2005	12:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.53
JMAA-02-RI	7/25/2005	12:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.78
JMAA-02-RI	7/25/2005	13:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7
JMAA-02-RI	7/25/2005	13:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.2
JMAA-02-RI	7/25/2005	14:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.43
JMAA-02-RI	7/25/2005	14:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.51
JMAA-02-RI	7/25/2005	15:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.55
JMAA-02-RI	7/25/2005	15:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.49
JMAA-02-RI	7/25/2005	16:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.45
JMAA-02-RI	7/25/2005	16:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.4
JMAA-02-RI	7/25/2005	17:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.37
JMAA-02-RI	7/25/2005	17:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.3
JMAA-02-RI	7/25/2005	18:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.24
JMAA-02-RI	7/25/2005	18:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.11
JMAA-02-RI	7/25/2005	19:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.04
JMAA-02-RI	7/25/2005	19:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.79
JMAA-02-RI	7/25/2005	20:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.64
JMAA-02-RI	7/25/2005	20:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.45
JMAA-02-RI	7/25/2005	21:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.3
JMAA-02-RI	7/25/2005	21:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.12
JMAA-02-RI	7/25/2005	22:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.09
JMAA-02-RI	7/25/2005	22:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.98
JMAA-02-RI	7/25/2005	23:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.8
JMAA-02-RI	7/25/2005	23:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.8
JMAA-02-RI	7/26/2005	0:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.68
JMAA-02-RI	7/26/2005	0:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.63
JMAA-02-RI	7/26/2005	1:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.54
JMAA-02-RI	7/26/2005	1:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.44
JMAA-02-RI	7/26/2005	2:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.43
JMAA-02-RI	7/26/2005	2:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.41
JMAA-02-RI	7/26/2005	3:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.38
JMAA-02-RI	7/26/2005	3:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.37
JMAA-02-RI	7/26/2005	4:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.36
JMAA-02-RI	7/26/2005	4:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.34
JMAA-02-RI	7/26/2005	5:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.32
JMAA-02-RI	7/26/2005	5:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.36
JMAA-02-RI	7/26/2005	6:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.35
JMAA-02-RI	7/26/2005	6:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.39
JMAA-02-RI	7/26/2005	7:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.38

Continuous Dissolved Oxygen Data
Cahokia Canal/Horseshoe Lake Watershed

JMAA-02-RI	7/26/2005	7:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.43
JMAA-02-RI	7/26/2005	8:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.48
JMAA-02-RI	7/26/2005	8:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.54
JMAA-02-RI	7/26/2005	9:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.63
JMAA-02-RI	7/26/2005	9:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.72
JMAA-02-RI	7/26/2005	10:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.8
JMAA-02-RI	7/26/2005	10:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.99
JMAA-02-RI	7/26/2005	11:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.17
JMAA-02-RI	7/26/2005	11:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.41
JMAA-02-RI	7/26/2005	12:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.66
JMAA-02-RI	7/26/2005	12:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.95
JMAA-02-RI	7/26/2005	13:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.22
JMAA-02-RI	7/26/2005	13:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.45
JMAA-02-RI	7/26/2005	14:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.67
JMAA-02-RI	7/26/2005	14:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.8
JMAA-02-RI	7/26/2005	15:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.79
JMAA-02-RI	7/26/2005	15:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.78
JMAA-02-RI	7/26/2005	16:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.83
JMAA-02-RI	7/26/2005	16:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.72
JMAA-02-RI	7/26/2005	17:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.55
JMAA-02-RI	7/26/2005	17:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.55
JMAA-02-RI	7/26/2005	18:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.5
JMAA-02-RI	7/26/2005	18:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.45
JMAA-02-RI	7/26/2005	19:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.32
JMAA-02-RI	7/26/2005	19:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.13
JMAA-02-RI	7/26/2005	20:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.94
JMAA-02-RI	7/26/2005	20:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.79
JMAA-02-RI	7/26/2005	21:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.55
JMAA-02-RI	7/26/2005	21:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.38
JMAA-02-RI	7/26/2005	22:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.24
JMAA-02-RI	7/26/2005	22:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.1
JMAA-02-RI	7/26/2005	23:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.02
JMAA-02-RI	7/26/2005	23:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.97
JMAA-02-RI	7/27/2005	0:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.91
JMAA-02-RI	7/27/2005	0:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.86
JMAA-02-RI	7/27/2005	1:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.88
JMAA-02-RI	7/27/2005	1:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.88
JMAA-02-RI	7/27/2005	2:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.92
JMAA-02-RI	7/27/2005	2:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.9
JMAA-02-RI	7/27/2005	3:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.93
JMAA-02-RI	7/27/2005	3:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.97
JMAA-02-RI	7/27/2005	4:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.99
JMAA-02-RI	7/27/2005	4:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.99
JMAA-02-RI	7/27/2005	5:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.99
JMAA-02-RI	7/27/2005	5:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.97
JMAA-02-RI	7/27/2005	6:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.96
JMAA-02-RI	7/27/2005	6:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.94
JMAA-02-RI	7/27/2005	7:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.94
JMAA-02-RI	7/27/2005	7:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.95
JMAA-02-RI	7/27/2005	8:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	5.96
JMAA-02-RI	7/27/2005	8:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6
JMAA-02-RI	7/27/2005	9:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.03
JMAA-02-RI	7/27/2005	9:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.12
JMAA-02-RI	7/27/2005	10:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.18
JMAA-02-RI	7/27/2005	10:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.32

Continuous Dissolved Oxygen Data
Cahokia Canal/Horseshoe Lake Watershed

JMAA-02-RI	7/27/2005	11:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.5
JMAA-02-RI	7/27/2005	11:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.72
JMAA-02-RI	7/27/2005	12:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.96
JMAA-02-RI	7/27/2005	12:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.28
JMAA-02-RI	7/27/2005	13:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.52
JMAA-02-RI	7/27/2005	13:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.8
JMAA-02-RI	7/27/2005	14:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.87
JMAA-02-RI	7/27/2005	14:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.96
JMAA-02-RI	7/27/2005	15:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.08
JMAA-02-RI	7/27/2005	15:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.19
JMAA-02-RI	7/27/2005	16:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.24
JMAA-02-RI	7/27/2005	16:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.22
JMAA-02-RI	7/27/2005	17:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.11
JMAA-02-RI	7/27/2005	17:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	8.05
JMAA-02-RI	7/27/2005	18:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.94
JMAA-02-RI	7/27/2005	18:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.75
JMAA-02-RI	7/27/2005	19:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.52
JMAA-02-RI	7/27/2005	19:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.3
JMAA-02-RI	7/27/2005	20:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.1
JMAA-02-RI	7/27/2005	20:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.99
JMAA-02-RI	7/27/2005	21:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.84
JMAA-02-RI	7/27/2005	21:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.71
JMAA-02-RI	7/27/2005	22:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.65
JMAA-02-RI	7/27/2005	22:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.6
JMAA-02-RI	7/27/2005	23:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.53
JMAA-02-RI	7/27/2005	23:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.49
JMAA-02-RI	7/28/2005	0:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.46
JMAA-02-RI	7/28/2005	0:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.44
JMAA-02-RI	7/28/2005	1:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.37
JMAA-02-RI	7/28/2005	1:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.37
JMAA-02-RI	7/28/2005	2:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.36
JMAA-02-RI	7/28/2005	2:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.41
JMAA-02-RI	7/28/2005	3:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.41
JMAA-02-RI	7/28/2005	3:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.43
JMAA-02-RI	7/28/2005	4:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.45
JMAA-02-RI	7/28/2005	4:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.43
JMAA-02-RI	7/28/2005	5:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.5
JMAA-02-RI	7/28/2005	5:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.49
JMAA-02-RI	7/28/2005	6:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.49
JMAA-02-RI	7/28/2005	6:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.54
JMAA-02-RI	7/28/2005	7:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.56
JMAA-02-RI	7/28/2005	7:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.57
JMAA-02-RI	7/28/2005	8:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.6
JMAA-02-RI	7/28/2005	8:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.65
JMAA-02-RI	7/28/2005	9:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.68
JMAA-02-RI	7/28/2005	9:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.74
JMAA-02-RI	7/28/2005	10:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	6.84
JMAA-02-RI	7/28/2005	10:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.04
JMAA-02-RI	7/28/2005	11:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.24
JMAA-02-RI	7/28/2005	11:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.47
JMAA-02-RI	7/28/2005	12:00:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.76
JMAA-02-RI	7/28/2005	12:30:00	NA	DISSOLVED OXYGEN (DO) mg/l	7.9

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Appendix D
Watershed Photographs

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Canteen Creek Southeast of Bluff Road Looking West

Canteen Creek Southeast of Bluff Road Looking West

Harding Ditch at Bunkham Road Looking North

Harding Ditch at Bunkham Road Looking South

Harding Ditch Southwest of Lake Boulevard Looking North

Frank Holten Lake #1 Looking Northwest Toward Saint Louis

Frank Holten Lake #2 Looking Northwest

Frank Holten Lake #3

Frank Holten Lake #3 Shoreline

Frank Holten Golf Course

Frank Holten Lake #3 with Golf Course in Background

Canteen Creek at Sand Prairie Road Looking West

Canteen Creek at Sand Prairie Road Looking East

Canteen Creek at Sand Prairie Road Looking West

Blue Heron in Horseshoe Lake

Horseshoe Lake East of Lake Road

Fisherman at Horseshoe Lake

Horseshoe Lake with U.S. Steel Facility in Background

Horseshoe Lake Looking West Toward Saint Louis

Cahokia Canal at Route 162 Looking South

Cahokia Canal at Route 162 Looking North

Cahokia Canal at Route 162 Looking South (Construction Activity)

Appendix E:
Cross Section Data and
Stream Photographs

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APPENDIX E: CROSS-SECTION DATA FOR CAHOKIA CANAL

Judy's Branch						
Measurement #	*Distance, y (ft)*	*width, w (ft)*	*Depth, z (ft)*	*Velocity at 0.6y (ft/s)*	*Area, A = w*z (ft^2)*	*Discharge, Q = V*A (cfs)*
1	0.0	0.0	0.0	0.00	0.00	0.00
2	1.0	1.0	0.3	0.75	0.30	0.23
3	2.0	1.0	0.4	0.51	0.40	0.20
4	3.0	1.0	0.4	0.95	0.40	0.38
5	4.0	1.0	0.4	1.10	0.40	0.44
6	5.0	1.0	0.4	1.03	0.40	0.41
7	6.0	1.0	0.4	1.32	0.40	0.53
8	7.0	1.0	0.5	0.87	0.50	0.44
9	8.0	1.0	0.6	1.30	0.60	0.78
10	9.0	1.0	0.7	1.10	0.70	0.77
11	10.0	1.0	0.7	0.75	0.70	0.53
12	10.3	0.3	0.0	0.00	0.00	0.00
Stream Conditions: No visible flow					**Total Q (cfs)**	4.7
					Total Area (ft^2)	4.1
					Average Velocity	0.8
					Stream Width (ft)	10.3

Confluence with Judy's Branch

APPENDIX E: CROSS-SECTION DATA FOR CAHOKIA CANAL

Horseshoe Lake Rd						
Measurement #	*Distance, y (ft)*	*width, w (ft)*	*Depth, z (ft)*	*Velocity at 0.6y (ft/s)*	*Area, A = w*z (ft^2)*	*Discharge, Q = V*A (cfs)*
1	0.0	0	0	0	0.00	0.00
2	2.0	2	0.9	0.18	1.80	0.34
3	4.0	2	1.1	0.19	2.20	0.46
4	6.0	2	1.1	0.21	2.20	0.99
5	8.0	2	0.6	0.45	1.20	0.40
6	10.0	2	1.2	0.33	2.40	0.84
7	12.0	2	1	0.35	2.00	0.80
8	14.0	2	1	0.40	2.00	0.52
9	16.0	2	0.9	0.26	1.80	0.00
Stream Conditions:					**Total Q (cfs)**	4.35
					Total Area (ft2)	15.6
					Average Velocity	0.26
					Stream Width (ft)	16.0

APPENDIX E: CROSS-SECTION DATA FOR CAHOKIA CANAL

Sand Prairie Road						
Measurement #	*Distance, y (ft)*	*width, w (ft)*	*Depth, z (ft)*	*Velocity at 0.6y (ft/s)*	*Area, A = w*z (ft^2)*	*Discharge, Q = V*A (cfs)*
1	0	0	0.00	0	0.00	0.00
2	2	2	2.10	0.130	4.20	0.63
3	4	2	2.60	0.150	5.20	0.52
4	6	2	2.60	0.100	5.20	0.47
5	8	2	2.70	0.090	5.40	1.13
6	10	2	2.70	0.210	5.40	1.13
7	12	2	2.50	0.210	5.00	1.00
8	14	2	2.30	0.200	4.60	0.00
9	16	2	1.90	0.000	3.80	0.00
10	18	2	1.00	0.000	2.00	0.00
Stream Conditions:					**Total Q (cfs)**	4.89
					Total Area (ft^2)	40.8
					Average Velocity	0.11
					Stream Width (ft)	18.0

APPENDIX E: CROSS-SECTION DATA FOR CAHOKIA CANAL

Rt 111						
Measurement #	*Distance, y (ft)*	*width, w (ft)*	*Depth, z (ft)*	*Velocity at 0.6y (ft/s)*	*Area, A = w*z (ft^2)*	*Discharge, Q = V*A (cfs)*
1	0.0	0.0	0	0.00	0.00	0.00
2	5.0	5.0	1.2	0.19	6.00	1.14
3	10.0	5.0	1.4	0.14	7.00	0.98
4	15.0	5.0	2.4	0.25	12.00	3.00
5	20.0	5.0	2.8	0.19	14.00	2.66
6	25.0	5.0	2.7	0.23	13.50	3.11
7	30.0	5.0	2.9	0.26	14.50	3.77
8	35.0	5.0	3.1	0.27	15.50	4.19
9	40.0	5.0	3.0	0.22	15.00	3.30
10	42.0	2.0	0.0	0.00	0.00	0.00
Stream Conditions:					**Total Q (cfs)**	22.1
					Total Area (ft^2)	97.5
					Average Velocity	0.2
					Stream Width (ft)	42.0

Appendix F:
QUAL2K Model
Cahokia Canal

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QUAL2K FORTRAN

Stream Water Quality Model

Steve Chapra, Hua Tao and Greg Pelletier

Version 2.07

System ID:		
River name	**Cahokia Canal**	
Saved file name	**Cahokia_FINAL**	
Directory where file saved	**C:\qual2k**	
Month	**7**	
Day	**31**	
Year	**2006**	
Time zone	**Central**	
Daylight savings time	**Yes**	
Calculation:		
Calculation step	**0.0625**	**hours**
Final time	**25**	**day**
Solution method (integration)	**Euler**	
Solution method (pH)	**Bisection**	
Program determined calc step	**0.046875**	**hours**
Time of last calculation	**1.45**	**minutes**
Time of sunrise	**6:01 AM**	
Time of solar noon	**1:07 PM**	
Time of sunset	**8:12 PM**	
Photoperiod	**14.18**	**hours**

QUAL2K
Stream Water Quality Model
Cahokia Canal (7/31/2006)
Headwater Data:

cfs = 4.15893841

Note: **** required field***

ID	Number of Headwaters*	2																
No. 1	**Reach No.***	**Headwater Name**	**Flow***	**Elevation**	**Weir**				**Rating Curves**				**Manning Formula**					**Prescribed**
			Rate		**Height**	**Width**	**adam**	**bdam**	**Velocity**		**Depth**		**Channel**	**Manning**	**Bot Width**	**Side**	**Side**	**Dispersion**
			(m^3/s)	**(m)**	**(m)**	**(m)**			**Coefficient**	**Exponent**	**Coefficient**	**Exponent**	**Slope**	**n**	**m**	**Slope**	**Slope**	**m2/s**
	1	Cahokia headwater	0.118	125.100			1.2500	0.9000	0.2500	0.000	0.1500	0.000						

Headwater Water Quality	Units	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM
Temperature	C	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66	22.66
Conductivity	umhos																							
Inorganic Solids	mgD/L																							
Dissolved Oxygen	mg/L	5.78	5.78	5.78	5.78	5.78	5.78	5.78	5.78	5.78	5.78	5.78	5.78	5.78	5.78	5.78	5.78	5.78	5.78	5.78	5.78	5.78	5.78	5.78
CBODslow	mgO2/L																							
CBODfast	mgO2/L	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Organic Nitrogen	ugN/L	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00	1740.00
NH4-Nitrogen	ugN/L	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00	110.00
NO3-Nitrogen	ugN/L	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00	490.00
Organic Phosphorus	ugP/L	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Inorganic Phosphorus (SRP)	ugP/L	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00	190.00
Phytoplankton	ugA/L	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Detritus (POM)	mgD/L																							
Pathogen	cfu/100 mL																							
Alkalinity	mgCaCO3/L	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
pH	s.u.	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00

No. 2	Reach No.*	Headwater Name	Flow*	Elevation	Weir				Rating Curves				Manning Formula					Prescribed
			Rate		**Height**	**Width**	**adam**	**bdam**	**Velocity**		**Depth**		**Channel**	**Manning**	**Bot Width**	**Side**	**Side**	**Dispersion**
			(m^3/s)	**(m)**	**(m)**	**(m)**			**Coefficient**	**Exponent**	**Coefficient**	**Exponent**	**Slope**	**n**	**m**	**Slope**	**Slope**	**m2/s**
	4	Canteen Creek Trib	0.2563				1.2500	0.9000					0.0001	0.0250	6.70	0.2400	0.4400	

	Units	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM
Temperature	C	22.13	22.13	22.13	22.13	22.13	22.13	22.13	22.13	22.13	22.13	22.13	22.13	22.13	22.13	22.13	22.13	22.13	22.13	22.13	22.13	22.13	22.13	22.13
Conductivity	umhos																							
Inorganic Solids	mgD/L																							
Dissolved Oxygen	mg/L	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
CBODslow	mgO2/L																							
CBODfast	mgO2/L	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Organic Nitrogen	ugN/L	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00	2300.00
NH4-Nitrogen	ugN/L	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00
NO3-Nitrogen	ugN/L	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00	10700.00
Organic Phosphorus	ugP/L	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00	460.00
Inorganic Phosphorus (SRP)	ugP/L	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00	1600.00
Phytoplankton	ugA/L	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Detritus (POM)	mgD/L																							
Pathogen	cfu/100 mL																							
Alkalinity	mgCaCO3/L	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
pH	s.u.	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00

QUAL2K

Stream Water Quality Model

Cahokia Canal (7/31/2006)

Reach Data:

																	Hydra
Reach for diel plot	3																
Element for diel plot	2	*Reach*	*Headwater*	*Reach*			*Location*		*Element*	*Elevation*		*Downstream*					
Reach	*Downstream*	*Number*	*Reach*	*length*	*Downstream*		*Upstream*	*Downstream*	*Number*	*Upstream*	*Downstream*	*Latitude*			*Longitude*		
Label	*end of reach label*			*(km)*	*Latitude*	*Longitude*	*(km)*	*(km)*	*>=1*	*(m)*	*(m)*	*Degrees*	*Minutes*	*Seconds*	*Degrees*	*Minutes*	*Seconds*
Cahokia Headwaters	I-255 bridge	1	Yes	4.19	38.72	90.03	19.230	15.041	2	125.100	123.500	38.00	43	20	90.00	1	44.26
Reach 2	Horseshoe Lake Road	2		3.29	38.69	90.04	15.041	11.750	2	123.500	122.100	38.00	41	36	90.00	2	21.95
JN02 WQ location	Canteen Creek	3		2.54	38.67	90.07	11.750	9.214	2	122.100	120.450	38.00	40	2	90.00	4	5.6
Canteen Creek Trib	Cahokia	4	Yes	1.75	38.67	90.07	1.750	0.000	2	122.100	120.450	38.00	40	2	90.00	4	5.6
Reach 4	Horseshoe Lake Outflow	5		4.22	38.66	90.10	9.214	4.995	2	120.450	120.240	38.00	39	51	90.00	5	48.93
Reach 5	Rt 203 Crossing	6		3.73	38.64	90.14	4.995	1.270	2	120.240	118.500	38.00	38	23	90.00	8	6.37
Reach 6	Mississippi River	7		1.27	38.64	90.18	1.270	0.000	2	118.500	115.000	38.00	38	41	90.00	10	42.66

aulic Model (Weir Overrides Manning Formula; Manning Formula Override Rating Curves)																					
Weir				Rating Curves				Manning Formula					Prescribed	Bottom	Bottom	Prescribed	Prescribed	Prescribed	Prescribed		
Height	Width	adam	bdam	Velocity		Depth		Channel	Manning	Bot Width	Side	Side	Dispersion	Algae	SOD	SOD	CH4 flux	NH4 flux	Inorg P flux		
(m)	(m)			Coefficient	Exponent	Coefficient	Exponent	Slope	n	m	Slope	Slope	m2/s	Coverage	Coverage	gO2/m2/d	gO2/m2/d	mgN/m2/d	mgP/m2/d		
		1.2500	0.9000	0.2500	0.000	0.1500	0.000	0.0013			0.3000	0.3500		50.00%	50.00%		0.0000	0.0000	0.0000		
		1.2500	0.9000	0.0800	0.000	0.3000	0.000	0.0004			0.4500	0.9000		50.00%	50.00%		0.0000	0.0000	0.0000		
		1.2500	0.9000	0.0300	0.000	0.6900	0.000	0.0004			0.5750	0.6500		50.00%	50.00%		0.0000	0.0000	0.0000		
		1.2500	0.9000					0.0020	0.0250	5.00	0.2500	0.2500									
		1.2500	0.9000	0.0500	0.000	0.7400	0.000	0.0001			0.2400	0.4400		50.00%	50.00%		0.0000	0.0000	0.0000		
		1.2500	0.9000	0.0305	0.000	1.2200	0.000	0.0051			0.1398	0.1586		50.00%	50.00%		0.0000	0.0000	0.0000		
		1.2500	0.9000	0.0305	0.000	1.2200	0.000	0.0008			0.2100	0.3340		50.00%	50.00%		0.0000	0.0000	0.0000		

QUAL2K

Stream Water Quality Model

Cahokia Canal (7/31/2006)

Air Temperature Data:

				Upstream	*Downstream*	*12:00 AM*	*1:00 AM*	*2:00 AM*	*3:00 AM*	*4:00 AM*	*5:00 AM*	*6:00 AM*	*7:00 AM*
Upstream	*Reach*	*Downstream*	*Reach*	*Distance*	*Distance*	*Hourly air temperature for each reach (degrees C)*							
Label	*Label*	*Label*	*Number*	*km*	*km*	*(The input values are applied as point estimates at each time. Linear interpolation is used to estimat*							
Cahokia headwater	Cahokia Headwaters	I-255 bridge	1	19.23	15.04	28.30	28.30	27.80	27.80	27.80	27.80	29.40	31.10
I-255 bridge	Reach 2	Horseshoe Lake Road	2	15.04	11.75	28.30	28.30	27.80	27.80	27.80	27.80	29.40	31.10
Horseshoe Lake Road	JN02 WQ location	Canteen Creek	3	11.75	9.21	28.30	28.30	27.80	27.80	27.80	27.80	29.40	31.10
Canteen Creek Trib	Canteen Creek Trib	Cahokia	4	1.75	0.00	28.30	28.30	27.80	27.80	27.80	27.80	29.40	31.10
Cahokia	Reach 4	Horseshoe Lake Outfl	5	9.21	4.99	28.30	28.30	27.80	27.80	27.80	27.80	29.40	31.10
Horseshoe Lake Outfl	Reach 5	Rt 203 Crossing	6	4.99	1.27	28.30	28.30	27.80	27.80	27.80	27.80	29.40	31.10
Rt 203 Crossing	Reach 6	Mississippi River	7	1.27	0.00								

8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
te values between the hourly inputs.)															
32.80	33.90	35.00	36.70	37.20	37.80	37.80	37.20	37.20	36.10	34.40	33.30	32.80	31.10	30.60	29.40
32.80	33.90	35.00	36.70	37.20	37.80	37.80	37.20	37.20	36.10	34.40	33.30	32.80	31.10	30.60	29.40
32.80	33.90	35.00	36.70	37.20	37.80	37.80	37.20	37.20	36.10	34.40	33.30	32.80	31.10	30.60	29.40
32.80	33.90	35.00	36.70	37.20	37.80	37.80	37.20	37.20	36.10	34.40	33.30	32.80	31.10	30.60	29.40
32.80	33.90	35.00	36.70	37.20	37.80	37.80	37.20	37.20	36.10	34.40	33.30	32.80	31.10	30.60	29.40
32.80	33.90	35.00	36.70	37.20	37.80	37.80	37.20	37.20	36.10	34.40	33.30	32.80	31.10	30.60	29.40

QUAL2K
Stream Water Quality Model
Cahokia Canal (7/31/2006)
Dew Point Temperature Data:

				Upstream	Downstream	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM
Upstream	*Reach*	*Downstream*	*Reach*	*Distance*	*Distance*	*Hourly dewpoint temperature for each reach (degrees C)*							
Label	*Label*	*Label*	*Number*	*km*	*km*	*(The input values are applied as point estimates at each time. Linear interpolation is used to estima*							
Cahokia headwater	Cahokia Headwaters	I-255 bridge	1	19.230	15.041	22.80	22.80	22.80	22.80	22.20	22.20	22.20	21.70
I-255 bridge	Reach 2	Horseshoe Lake Road	2	15.041	11.750	22.80	22.80	22.80	22.80	22.20	22.20	22.20	21.70
Horseshoe Lake Road	JN02 WQ location	Canteen Creek	3	11.750	9.214	22.80	22.80	22.80	22.80	22.20	22.20	22.20	21.70
Canteen Creek Trib	Canteen Creek Trib	Cahokia	4	1.750	0.000	22.80	22.80	22.80	22.80	22.20	22.20	22.20	21.70
Cahokia	Reach 4	Horseshoe Lake Outfl	5	9.214	4.995	22.80	22.80	22.80	22.80	22.20	22.20	22.20	21.70
Horseshoe Lake Outfl	Reach 5	Rt 203 Crossing	6	4.995	1.270	22.80	22.80	22.80	22.80	22.20	22.20	22.20	21.70
Rt 203 Crossing	Reach 6	Mississippi River	7	1.270	0.000	22.80	22.80	22.80	22.80	22.20	22.20	22.20	21.70

8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
te values between the hourly inputs.															
21.70	21.70	21.10	21.10	20.00	20.60	19.40	20.00	20.60	19.40	20.00	20.60	20.60	21.70	22.80	22.80
21.70	21.70	21.10	21.10	20.00	20.60	19.40	20.00	20.60	19.40	20.00	20.60	20.60	21.70	22.80	22.80
21.70	21.70	21.10	21.10	20.00	20.60	19.40	20.00	20.60	19.40	20.00	20.60	20.60	21.70	22.80	22.80
21.70	21.70	21.10	21.10	20.00	20.60	19.40	20.00	20.60	19.40	20.00	20.60	20.60	21.70	22.80	22.80
21.70	21.70	21.10	21.10	20.00	20.60	19.40	20.00	20.60	19.40	20.00	20.60	20.60	21.70	22.80	22.80
21.70	21.70	21.10	21.10	20.00	20.60	19.40	20.00	20.60	19.40	20.00	20.60	20.60	21.70	22.80	22.80
21.70	21.70	21.10	21.10	20.00	20.60	19.40	20.00	20.60	19.40	20.00	20.60	20.60	21.70	22.80	22.80

QUAL2K
Stream Water Quality Model
Cahokia Canal (7/31/2006)
Wind Speed Data:

				Upstream	Downstream	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM
Upstream	Reach	Downstream	Reach	Distance	Distance	Wind speed for each reach 7m above water surface (m/s)							
Label	Label	Label	Number	km	km	(The input values are applied as point estimates at each time. Linear interpolation is used to estimat							
Cahokia headwater	Cahokia Headwaters	I-255 bridge	1	19.230	15.041	4.02	3.13	4.47	3.58	3.58	2.68	2.68	3.58
I-255 bridge	Reach 2	Horseshoe Lake Road	2	15.041	11.750	4.02	3.13	4.47	3.58	3.58	2.68	2.68	3.58
Horseshoe Lake Road	JN02 WQ location	Canteen Creek	3	11.750	9.214	4.02	3.13	4.47	3.58	3.58	2.68	2.68	3.58
Canteen Creek Trib	Canteen Creek Trib	Cahokia	4	1.750	0.000	4.02	3.13	4.47	3.58	3.58	2.68	2.68	3.58
Cahokia	Reach 4	Horseshoe Lake Outfl	5	9.214	4.995	4.02	3.13	4.47	3.58	3.58	2.68	2.68	3.58
Horseshoe Lake Outfl	Reach 5	Rt 203 Crossing	6	4.995	1.270	4.02	3.13	4.47	3.58	3.58	2.68	2.68	3.58
Rt 203 Crossing	Reach 6	Mississippi River	7	1.270	0.000	4.02	3.13	4.47	3.58	3.58	2.68	2.68	3.58

8:00 AM	*9:00 AM*	*10:00 AM*	*11:00 AM*	*12:00 PM*	*1:00 PM*	*2:00 PM*	*3:00 PM*	*4:00 PM*	*5:00 PM*	*6:00 PM*	*7:00 PM*	*8:00 PM*	*9:00 PM*	*10:00 PM*	*11:00 PM*
te values between the hourly inputs.)															
3.13	3.58	3.58	2.68	4.47	4.47	6.26	4.47	6.71	7.15	6.26	4.92	4.92	4.92	4.92	3.13
3.13	3.58	3.58	2.68	4.47	4.47	6.26	4.47	6.71	7.15	6.26	4.92	4.92	4.92	4.92	3.13
3.13	3.58	3.58	2.68	4.47	4.47	6.26	4.47	6.71	7.15	6.26	4.92	4.92	4.92	4.92	3.13
3.13	3.58	3.58	2.68	4.47	4.47	6.26	4.47	6.71	7.15	6.26	4.92	4.92	4.92	4.92	3.13
3.13	3.58	3.58	2.68	4.47	4.47	6.26	4.47	6.71	7.15	6.26	4.92	4.92	4.92	4.92	3.13
3.13	3.58	3.58	2.68	4.47	4.47	6.26	4.47	6.71	7.15	6.26	4.92	4.92	4.92	4.92	3.13
3.13	3.58	3.58	2.68	4.47	4.47	6.26	4.47	6.71	7.15	6.26	4.92	4.92	4.92	4.92	3.13

QUAL2K
Stream Water Quality Model
Cahokia Canal (7/31/2006)
Cloud Cover Data:

				Upstream	Downstream	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM
Upstream	Reach	Downstream	Reach	Distance	Distance	Hourly cloud cover shade for each reach (Percent)							
Label	Label	Label	Number	km	km	(Percent of sky that is covered by clouds. The input values are applied as point estimates at each tin							
Cahokia headwater	Cahokia Headwaters	I-255 bridge	1	19.230	15.041	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
I-255 bridge	Reach 2	Horseshoe Lake Road	2	15.041	11.750	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
Horseshoe Lake Road	JN02 WQ location	Canteen Creek	3	11.750	9.214	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
Canteen Creek Trib	Canteen Creek Trib	Cahokia	4	1.750	0.000	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
Cahokia	Reach 4	Horseshoe Lake Outfl	5	9.214	4.995	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
Horseshoe Lake Outfl	Reach 5	Rt 203 Crossing	6	4.995	1.270	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
Rt 203 Crossing	Reach 6	Mississippi River	7	1.270	0.000	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%

8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
me. Linear interpolation is used to estimate values between the hourly inputs.)															
25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%
25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%

QUAL2K
Stream Water Quality Model
Cahokia Canal (7/31/2006)
Shade Data:

				Upstream	Downstream	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM
Upstream	Reach	Downstream	Reach	Distance	Distance	Integrated hourly effective shade for each reach (Percent)							
Label	Label	Label	Number	km	km	(Percent of solar radiation that is blocked because of shade from topography and vegetation. Hourly							
Cahokia headwater	Cahokia Headwaters	I-255 bridge	1	19.230	15.041	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
I-255 bridge	Reach 2	Horseshoe Lake Road	2	15.041	11.750	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Horseshoe Lake Road	JN02 WQ location	Canteen Creek	3	11.750	9.214	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Canteen Creek Trib	Canteen Creek Trib	Cahokia	4	1.750	0.000	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Cahokia	Reach 4	Horseshoe Lake Outfl	5	9.214	4.995	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Horseshoe Lake Outfl	Reach 5	Rt 203 Crossing	6	4.995	1.270	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Rt 203 Crossing	Reach 6	Mississippi River	7	1.270	0.000	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
y values are applied as integrated values for each hour, e.g. the value at 12:00 AM is applied from 12:00 to 1:00 AM)															
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

QUAL2K

Stream Water Quality Model

Cahokia Canal (7/31/2006)

Water Column Rates

Parameter	Value	Units	Symbol
Stoichiometry:			
Carbon	40	gC	gC
Nitrogen	7.2	gN	gN
Phosphorus	1	gP	gP
Dry weight	100	gD	gD
Chlorophyll	1	gA	gA
Inorganic suspended solids:			
Settling velocity	0.3	m/d	v_i
Oxygen:			
Reaeration model	Internal		
User reaeration coefficient α	3.93		α
User reaeration coefficient β	0.5		β
User reaeration coefficient γ	1.5		γ
Temp correction	1.024		θ_a
Reaeration wind effect	Banks-Herrera		
O2 for carbon oxidation	2.69	gO_2/gC	r_{oc}
O2 for NH4 nitrification	4.57	gO_2/gN	r_{on}
Oxygen inhib model CBOD oxidation	Exponential		
Oxygen inhib parameter CBOD oxidation	0.60	L/mgO2	K_{socf}
Oxygen inhib model nitrification	Exponential		
Oxygen inhib parameter nitrification	0.60	L/mgO2	K_{sona}
Oxygen enhance model denitrification	Exponential		
Oxygen enhance parameter denitrification	0.60	L/mgO2	K_{sodn}
Oxygen inhib model phyto resp	Exponential		
Oxygen inhib parameter phyto resp	0.60	L/mgO2	K_{sop}
Oxygen enhance model bot alg resp	Exponential		
Oxygen enhance parameter bot alg resp	0.60	L/mgO2	K_{sob}
Slow CBOD:			
Hydrolysis rate	0.1	/d	k_{hc}
Temp correction	1.07		θ_{hc}
Oxidation rate	0	/d	k_{dcs}
Temp correction	1.047		θ_{dcs}
Fast CBOD:			
Oxidation rate	0.23	/d	k_{dc}
Temp correction	1.047		θ_{dc}

Organic N:			
Hydrolysis	**0.2**	**/d**	k_{hn}
Temp correction	**1.07**		θ_{hn}
Settling velocity	**0.1**	**m/d**	v_{on}
Ammonium:			
Nitrification	**1**	**/d**	k_{na}
Temp correction	**1.07**		θ_{na}
Nitrate:			
Denitrification	**0**	**/d**	k_{dn}
Temp correction	**1.07**		θ_{dn}
Sed denitrification transfer coeff	**0**	**m/d**	v_{di}
Temp correction	**1.07**		θ_{di}
Organic P:			
Hydrolysis	**0.2**	**/d**	k_{hp}
Temp correction	**1.07**		θ_{hp}
Settling velocity	**0.1**	**m/d**	v_{op}
Inorganic P:			
Settling velocity	**2**	**m/d**	v_{ip}
Inorganic P sorption coefficient	**0**	**L/mgD**	K_{dpi}
Sed P oxygen attenuation half sat constant	**0.05**	**mgO_2/L**	k_{spi}
Phytoplankton:			
Max Growth rate	**2.5**	**/d**	k_{gp}
Temp correction	**1.07**		θ_{gp}
Respiration rate	**0.2**	**/d**	k_{rp}
Temp correction	**1.07**		θ_{rp}
Death rate	**0.2**	**/d**	k_{dp}
Temp correction	**1.07**		θ_{dp}
Nitrogen half sat constant	**25**	**ugN/L**	k_{sPp}
Phosphorus half sat constant	**5**	**ugP/L**	k_{sNp}
Inorganic carbon half sat constant	**1.30E-05**	**moles/L**	k_{sCp}
Light model	**Half saturation**		
Light constant	**100**	**langleys/d**	K_{Lp}
Ammonia preference	**25**	**ugN/L**	k_{hnxp}
Settling velocity	**0.5**	**m/d**	v_a

Bottom Algae:			
Growth model	**Zero-order**		
Max Growth rate	**50**	**mgA/m^2/d or /d**	C_{gb}
Temp correction	**1.07**		θ_{gb}
First-order model carrying capacity	**1000**	**mgA/m^2**	$a_{b,max}$
Respiration rate	**0.1**	**/d**	k_{rb}
Temp correction	**1.07**		θ_{rb}
Excretion rate	**0.05**	**/d**	k_{eb}
Temp correction	**1.07**		θ_{db}
Death rate	**0.1**	**/d**	k_{db}
Temp correction	**1.07**		θ_{db}
External nitrogen half sat constant	**300**	**ugN/L**	k_{sPb}
External phosphorus half sat constant	**100**	**ugP/L**	k_{sNb}
Inorganic carbon half sat constant	**1.30E-05**	**moles/L**	k_{sCb}
Light model	**Half saturation**		
Light constant	**100**	**langleys/d**	K_{Lb}
Ammonia preference	**25**	**ugN/L**	k_{hnxb}
Subsistence quota for nitrogen	**0.72**	**mgN/mgA**	q_{0N}
Subsistence quota for phosphorus	**0.1**	**mgP/mgA**	q_{0P}
Maximum uptake rate for nitrogen	**72**	**mgN/mgA/d**	ρ_{mN}
Maximum uptake rate for phosphorus	**5**	**mgP/mgA/d**	ρ_{mP}
Internal nitrogen half sat constant	**0.9**	**mgN/mgA**	K_{qN}
Internal phosphorus half sat constant	**0.13**	**mgP/mgA**	K_{qP}
Detritus (POM):			
Dissolution rate	**0.5**	**/d**	k_{dt}
Temp correction	**1.07**		θ_{dt}
Fraction of dissolution to fast CBOD	**1.00**		F_f
Settling velocity	**0.1**	**m/d**	v_{dt}
Pathogens:			
Decay rate	**0.8**	**/d**	k_{dx}
Temp correction	**1.07**		θ_{dx}
Settling velocity	**1**	**m/d**	v_x
Light efficiency factor	**1.00**		α_{path}
pH:			
Partial pressure of carbon dioxide	**347**	**ppm**	p_{CO2}

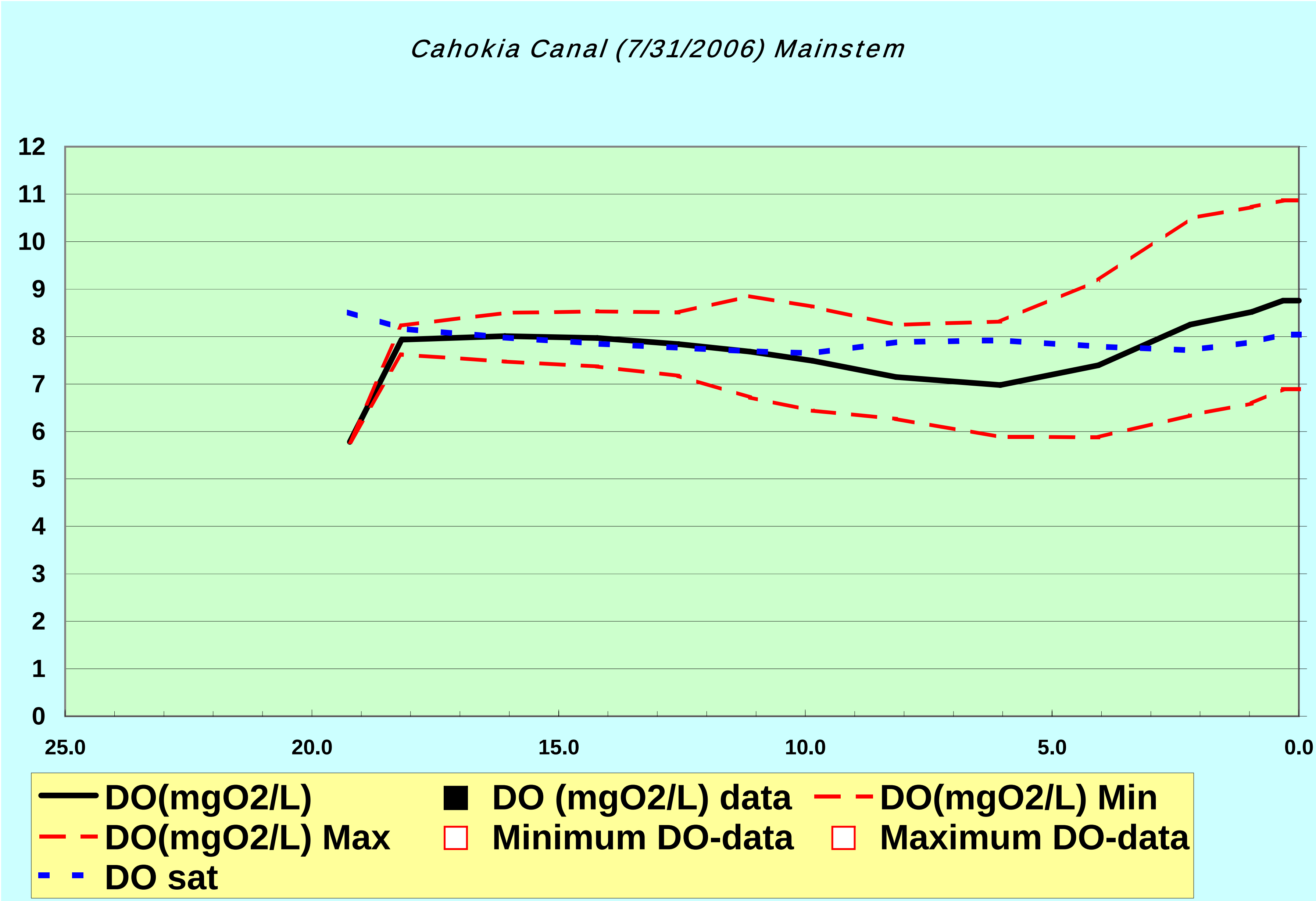
QUAL2K

Stream Water Quality Model

Cahokia Canal (7/31/2006)

Light Parameters and Surface Heat Transfer Models:

Parameter	*Value*	*Unit*	
Photosynthetically Available Radiation	0.47		
Background light extinction	0.2	*/m*	k_{eb}
Linear chlorophyll light extinction	0.0088	*1/m-(ugA/L)*	α_p
Nonlinear chlorophyll light extinction	0.054	*1/m-(ugA/L)2/3*	α_{pn}
ISS light extinction	0.052	*1/m-(mgD/L)*	α_i
Detritus light extinction	0.174	*1/m-(mgD/L)*	α_o
Solar shortwave radiation model			
Atmospheric attenuation model for solar	Bras		
Bras solar parameter (used if Bras solar model is selected)			
atmospheric turbidity coefficient (2=clear, 5=smoggy, default=2)	2		n_{fac}
Ryan-Stolzenbach solar parameter (used if Ryan-Stolzenbach solar model is selected)			
atmospheric transmission coefficient (0.70-0.91, default 0.8)	0.8		a_{tc}
Downwelling atmospheric longwave IR radiation			
atmospheric longwave emissivity model	Brunt		
Evaporation and air convection/conduction			
wind speed function for evaporation and air convection/conduction	Brady-Graves-Geyer		
Sediment heat parameters			
Sediment thermal thickness	15	*cm*	H_s
Sediment thermal diffusivity	0.0064	cm^2/s	α_s
Sediment density	1.6	g/cm^3	ρ_s
Water density	1	g/cm^3	ρ_w
Sediment heat capacity	0.4	$cal/(g\ ^oC)$	C_{ps}
Water heat capacity	1	$cal/(g\ ^oC)$	C_{pw}
Sediment diagenesis model			
Compute SOD and nutrient fluxes	Yes		



Cahokia Canal (7/31/2006) Mainstem
12
11
10
9
8
7
6
5
4
3
2
1
0
25.0
20.0
15.0
10.0
5.0
0.0
DO(mgO2/L)
DO (mgO2/L) data
DO(mgO2/L) Min
DO(mgO2/L) Max
Minimum DO-data
Maximum DO-data
DO sat

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Appendix G:
Load Duration Analysis
Canteen Creek

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Date	Indian Creek Mean Daily Flow Less Point Source	A_u/A_g	Collinsville Q	Q_{est}	Rank	Exceedance Probability	Total Mn (ug/L)	sec/day	L/ft^3	Lbs/ug	Product of conversions	Actual Load	Allowable Load
1/16/1991	325.655019	0.74	6.81	246.4	372.0	0.0153	467	86400	28.31685	2.20462E-09	0.005393776	621	1329
9/17/1998	151.655019	0.74	6.81	118.4	830.0	0.0342	270	86400	28.31685	2.20462E-09	0.005393776	172	639
4/22/1996	129.655019	0.74	6.81	102.2	967.0	0.0398	3800	86400	28.31685	2.20462E-09	0.005393776	2095	551
4/26/1993	102.655019	0.74	6.81	82.3	1181.0	0.0487	340	86400	28.31685	2.20462E-09	0.005393776	151	444
6/22/1998	100.655019	0.74	6.81	80.9	1204.0	0.0496	230	86400	28.31685	2.20462E-09	0.005393776	100	436
7/19/1993	79.655019	0.74	6.81	65.4	1440.0	0.0593	350	86400	28.31685	2.20462E-09	0.005393776	124	353
4/20/1992	69.655019	0.74	6.81	58.1	1574.0	0.0648	520	86400	28.31685	2.20462E-09	0.005393776	163	313
3/22/1993	54.655019	0.74	6.81	47.0	1897.0	0.0782	480	86400	28.31685	2.20462E-09	0.005393776	122	254
5/22/1995	51.655019	0.74	6.81	44.8	1966.0	0.0810	400	86400	28.31685	2.20462E-09	0.005393776	97	242
4/21/1997	49.655019	0.74	6.81	43.3	2031.0	0.0837	600	86400	28.31685	2.20462E-09	0.005393776	140	234
11/23/1992	49.655019	0.74	6.81	43.3	2030.0	0.0836	400	86400	28.31685	2.20462E-09	0.005393776	94	234
1/6/1993	48.655019	0.74	6.81	42.6	2085.0	0.0859	390	86400	28.31685	2.20462E-09	0.005393776	90	230
11/29/1993	43.655019	0.74	6.81	38.9	2272.0	0.0936	590	86400	28.31685	2.20462E-09	0.005393776	124	210
3/19/1997	43.655019	0.74	6.81	38.9	2273.0	0.0936	410	86400	28.31685	2.20462E-09	0.005393776	86	210
2/19/1991	40.655019	0.74	6.81	36.7	2403.0	0.0990	921	86400	28.31685	2.20462E-09	0.005393776	182	198
5/26/1998	40.655019	0.74	6.81	36.7	2404.0	0.0990	360	86400	28.31685	2.20462E-09	0.005393776	71	198
9/3/1991	37.655019	0.74	6.81	34.5	2585.0	0.1065	230	86400	28.31685	2.20462E-09	0.005393776	43	186
5/4/1994	34.655019	0.74	6.81	32.3	2747.0	0.1132	370	86400	28.31685	2.20462E-09	0.005393776	64	174
4/13/1998	23.655019	0.74	6.81	24.2	3778.0	0.1556	370	86400	28.31685	2.20462E-09	0.005393776	48	131
1/23/1995	21.655019	0.74	6.81	22.7	4059.0	0.1672	530	86400	28.31685	2.20462E-09	0.005393776	65	123
6/18/1990	20.655019	0.74	6.81	22.0	4232.0	0.1744	961	86400	28.31685	2.20462E-09	0.005393776	114	119
6/19/1995	20.655019	0.74	6.81	22.0	4233.0	0.1744	630	86400	28.31685	2.20462E-09	0.005393776	75	119
10/25/1993	16.655019	0.74	6.81	19.1	5018.0	0.2067	300	86400	28.31685	2.20462E-09	0.005393776	31	103
3/2/1998	15.655019	0.74	6.81	18.3	5242.0	0.2160	540	86400	28.31685	2.20462E-09	0.005393776	53	99
5/13/1991	15.655019	0.74	6.81	18.3	5240.0	0.2159	410	86400	28.31685	2.20462E-09	0.005393776	41	99
5/27/1997	15.655019	0.74	6.81	18.3	5241.0	0.2159	400	86400	28.31685	2.20462E-09	0.005393776	40	99
4/23/1991	14.655019	0.74	6.81	17.6	5516.0	0.2272	418	86400	28.31685	2.20462E-09	0.005393776	40	95
3/28/1994	12.655019	0.74	6.81	16.1	6178.0	0.2545	450	86400	28.31685	2.20462E-09	0.005393776	39	87
6/5/1996	12.655019	0.74	6.81	16.1	6179.0	0.2546	430	86400	28.31685	2.20462E-09	0.005393776	37	87
2/9/1994	10.655019	0.74	6.81	14.6	6922.0	0.2852	510	86400	28.31685	2.20462E-09	0.005393776	40	79
2/8/1993	9.655019	0.74	6.81	13.9	7347.0	0.3027	800	86400	28.31685	2.20462E-09	0.005393776	60	75
1/21/1997	9.655019	0.74	6.81	13.9	7348.0	0.3027	590	86400	28.31685	2.20462E-09	0.005393776	44	75
3/3/1992	9.255019	0.74	6.81	13.6	7742.0	0.3190	710	86400	28.31685	2.20462E-09	0.005393776	52	73
3/6/1995	7.555019	0.74	6.81	12.4	8735.0	0.3599	640	86400	28.31685	2.20462E-09	0.005393776	43	67
10/19/1998	7.355019	0.74	6.81	12.2	8835.0	0.3640	120	86400	28.31685	2.20462E-09	0.005393776	8	66
4/10/1995	7.155019	0.74	6.81	12.1	8923.0	0.3676	380	86400	28.31685	2.20462E-09	0.005393776	25	65
6/16/1993	6.755019	0.74	6.81	11.8	9188.0	0.3785	220	86400	28.31685	2.20462E-09	0.005393776	14	64
1/10/1994	6.655019	0.74	6.81	11.7	9224.0	0.3800	820	86400	28.31685	2.20462E-09	0.005393776	52	63
1/20/1998	6.455019	0.74	6.81	11.6	9397.0	0.3871	510	86400	28.31685	2.20462E-09	0.005393776	32	62
5/2/1990	6.255019	0.74	6.81	11.4	9553.0	0.3936	297	86400	28.31685	2.20462E-09	0.005393776	18	62
6/27/1994	5.955019	0.74	6.81	11.2	9760.0	0.4021	390	86400	28.31685	2.20462E-09	0.005393776	24	60
4/9/1990	5.655019	0.74	6.81	11.0	9936.0	0.4093	775	86400	28.31685	2.20462E-09	0.005393776	46	59

Date	Indian Creek Mean Daily Flow Less Point Source	A_u/A_g	Collinsville Q	Q_{est}	Rank	Exceedance Probability	Total Mn (ug/L)	sec/day	L/ft^3	Lbs/ug	Product of conversions	Actual Load	Allowable Load
3/5/1990	5.155019	0.74	6.81	10.6	10336.0	0.4258	729	86400	28.31685	2.20462E-09	0.005393776	42	57
8/1/1994	4.155019	0.74	6.81	9.9	11179.0	0.4606	75	86400	28.31685	2.20462E-09	0.005393776	4	53
6/15/1992	3.655019	0.74	6.81	9.5	11642.0	0.4796	160	86400	28.31685	2.20462E-09	0.005393776	8	51
11/18/1996	3.455019	0.74	6.81	9.4	11925.0	0.4913	510	86400	28.31685	2.20462E-09	0.005393776	26	50
5/26/1992	3.355019	0.74	6.81	9.3	12020.0	0.4952	280	86400	28.31685	2.20462E-09	0.005393776	14	50
7/25/1990	3.355019	0.74	6.81	9.3	12019.0	0.4952	265	86400	28.31685	2.20462E-09	0.005393776	13	50
1/29/1992	3.255019	0.74	6.81	9.2	12135.0	0.4999	860	86400	28.31685	2.20462E-09	0.005393776	43	50
7/17/1996	2.755019	0.74	6.81	8.8	12721.0	0.5241	190	86400	28.31685	2.20462E-09	0.005393776	9	48
7/24/1995	2.655019	0.74	6.81	8.8	12829.0	0.5285	310	86400	28.31685	2.20462E-09	0.005393776	15	47
12/14/1998	2.655019	0.74	6.81	8.8	12830.0	0.5286	240	86400	28.31685	2.20462E-09	0.005393776	11	47
7/29/1992	2.455019	0.74	6.81	8.6	13138.0	0.5413	220	86400	28.31685	2.20462E-09	0.005393776	10	46
11/25/1991	2.255019	0.74	6.81	8.5	13384.0	0.5514	510	86400	28.31685	2.20462E-09	0.005393776	23	46
3/20/1996	2.255019	0.74	6.81	8.5	13385.0	0.5514	180	86400	28.31685	2.20462E-09	0.005393776	8	46
12/12/1994	2.155019	0.74	6.81	8.4	13495.0	0.5560	480	86400	28.31685	2.20462E-09	0.005393776	22	45
2/14/1996	1.955019	0.74	6.81	8.2	13828.0	0.5697	560	86400	28.31685	2.20462E-09	0.005393776	25	44
9/8/1993	1.755019	0.74	6.81	8.1	14082.0	0.5802	130	86400	28.31685	2.20462E-09	0.005393776	6	44
10/15/1990	1.655019	0.74	6.81	8.0	14267.0	0.5878	167	86400	28.31685	2.20462E-09	0.005393776	7	43
8/17/1998	1.555019	0.74	6.81	8.0	14487.0	0.5968	170	86400	28.31685	2.20462E-09	0.005393776	7	43
6/5/1991	1.455019	0.74	6.81	7.9	14651.0	0.6036	160	86400	28.31685	2.20462E-09	0.005393776	7	42
9/24/1997	1.055019	0.74	6.81	7.6	15481.0	0.6378	150	86400	28.31685	2.20462E-09	0.005393776	6	41
11/26/1990	1.055019	0.74	6.81	7.6	15480.0	0.6377	116	86400	28.31685	2.20462E-09	0.005393776	5	41
7/9/1997	0.955019	0.74	6.81	7.5	15655.0	0.6450	220	86400	28.31685	2.20462E-09	0.005393776	9	41
1/22/1990	0.955019	0.74	6.81	7.5	15656.0	0.6450	527	86400	28.31685	2.20462E-09	0.005393776	21	41
1/8/1996	0.755019	0.74	6.81	7.4	16103.0	0.6634	540	86400	28.31685	2.20462E-09	0.005393776	21	40
8/26/1992	0.655019	0.74	6.81	7.3	16318.0	0.6723	120	86400	28.31685	2.20462E-09	0.005393776	5	39
9/16/1996	0.625019	0.74	6.81	7.3	16632.0	0.6852	210	86400	28.31685	2.20462E-09	0.005393776	8	39
8/28/1995	0.485019	0.74	6.81	7.2	16988.0	0.6999	860	86400	28.31685	2.20462E-09	0.005393776	33	39
12/8/1997	0.355019	0.74	6.81	7.1	17421.0	0.7177	180	86400	28.31685	2.20462E-09	0.005393776	7	38
10/21/1996	0.255019	0.74	6.81	7.0	17804.0	0.7335	250	86400	28.31685	2.20462E-09	0.005393776	9	38
9/14/1998	0.165019	0.74	6.81	6.9	18129.0	0.7469	130	86400	28.31685	2.20462E-09	0.005393776	5	37
7/29/1991	0.055019	0.74	6.81	6.8	18628.0	0.7674	107	86400	28.31685	2.20462E-09	0.005393776	4	37
7/18/1990	0.045019	0.74	6.81	6.8	18809.0	0.7749	152	86400	28.31685	2.20462E-09	0.005393776	6	37
11/27/1995	0.015019	0.74	6.81	6.8	18960.0	0.7811	140	86400	28.31685	2.20462E-09	0.005393776	5	37
11/3/1997	0.015019	0.74	6.81	6.8	18961.0	0.7812	120	86400	28.31685	2.20462E-09	0.005393776	4	37
9/26/1994	0.005019	0.74	6.81	6.8	18997.0	0.7826	1100	86400	28.31685	2.20462E-09	0.005393776	40	37
11/2/1994	0	0.74	6.81	6.8	19621.0	0.8083	120	86400	28.31685	2.20462E-09	0.005393776	4	37
9/5/1990	0	0.74	6.81	6.8	19901.0	0.8199	127	86400	28.31685	2.20462E-09	0.005393776	5	37
10/23/1995	0	0.74	6.81	6.8	20134.0	0.8295	190	86400	28.31685	2.20462E-09	0.005393776	7	37
8/13/1997	0	0.74	6.81	6.8	20813.0	0.8575	100	86400	28.31685	2.20462E-09	0.005393776	4	37
10/27/1992	0	0.74	6.81	6.8	21995.0	0.9062	88	86400	28.31685	2.20462E-09	0.005393776	3	37
10/1/1991	0	0.74	6.81	6.8	21994.0	0.9061	68	86400	28.31685	2.20462E-09	0.005393776	2	37

Appendix H:
Load Duration Analysis
Harding Ditch

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Date	Indian Q	Indian Q less Bunker Hill STP	A_u/A_g	Q_{est}	$Q_{est\ plus}$ Caseyville STP	Rank	Flow Exceedance %	Fecal Coliform (col/100mL)	100mL/ft^3	s/d	Actual Load (Mil Col/day)	Not-to-exceed load	Geometric mean load
7/19/1993	80	80	0.90	72.3	72.3	540	0.0439	20000.00	283.2	86400	35376689	707534	353767
6/12/2003	52	52	0.90	47.0	47.0	726	0.0590	8500.00	283.2	86400	9772810	459897	229948
5/22/1995	52	52	0.90	47.0	47.0	727	0.0591	4900.00	283.2	86400	5633738	459897	229948
9/3/1991	38	38	0.90	34.3	34.3	911	0.0741	5800.00	283.2	86400	4873139	336079	168039
5/4/1994	35	35	0.90	31.6	31.6	976	0.0794	20000.00	283.2	86400	15477301	309546	154773
6/2/2004	33	33	0.90	29.8	29.8	1017	0.0827	1320.00	283.2	86400	963130	291858	145929
6/18/1990	21	21	0.90	19.0	19.0	1429	0.1162	6000.00	283.2	86400	2785914	185728	92864
6/19/1995	21	21	0.90	19.0	19.0	1428	0.1161	2000.00	283.2	86400	928638	185728	92864
5/13/1991	16	16	0.90	14.5	14.5	1736	0.1412	590.00	283.2	86400	208722	141507	70753
6/5/1996	13	13	0.90	11.7	11.7	2035	0.1655	2700.00	283.2	86400	776076	114974	57487
6/16/1993	7.1	7.1	0.90	6.4	6.4	2975	0.2419	2200.00	283.2	86400	345365	62794	31397
5/2/1990	6.6	6.6	0.90	6.0	6.0	3112	0.2530	860.00	283.2	86400	125499	58372	29186
6/27/1994	6.3	6.3	0.90	5.7	5.7	3208	0.2609	7900.00	283.2	86400	1100436	55718	27859
6/28/2004	5.3	5.3	0.90	4.8	4.8	3536	0.2875	810.00	283.2	86400	94920	46874	23437
8/1/1994	4.5	4.5	0.90	4.1	4.1	3852	0.3132	2500.00	283.2	86400	248742	39799	19899
6/15/1992	4	4	0.90	3.6	3.6	4079	0.3317	20000.00	283.2	86400	1768834	35377	17688
5/26/1992	3.7	3.7	0.90	3.3	3.3	4240	0.3448	5800.00	283.2	86400	474490	32723	16362
7/25/1990	3.7	3.7	0.90	3.3	3.3	4241	0.3449	5600.00	283.2	86400	458128	32723	16362
7/17/1996	3.1	3.1	0.90	2.8	2.8	4595	0.3736	3600.00	283.2	86400	246752	27417	13708
7/24/1995	3	3	0.90	2.7	2.7	4689	0.3813	9800.00	283.2	86400	650047	26533	13266
7/29/1992	2.8	2.8	0.90	2.5	2.5	4812	0.3913	1160.00	283.2	86400	71815	24764	12382
9/8/1993	2.1	2.1	0.90	1.9	1.9	5392	0.4384	2900.00	283.2	86400	134653	18573	9286
10/15/1990	2	2	0.90	1.8	1.8	5512	0.4482	2700.00	283.2	86400	119396	17688	8844
6/5/1991	1.8	1.8	0.90	1.6	1.6	5717	0.4649	2400.00	283.2	86400	95517	15920	7960
8/10/2004	1.5	1.5	0.90	1.4	1.4	6064	0.4931	710.00	283.2	86400	23548	13266	6633
10/28/2003	1.2	1.2	0.90	1.1	1.1	6509	0.5293	1950.00	283.2	86400	51738	10613	5307
8/26/1992	1	1	0.90	0.9	0.9	6846	0.5567	560.00	283.2	86400	12382	8844	4422
9/16/1996	0.97	0.97	0.90	0.9	0.9	6888	0.5601	8000.00	283.2	86400	171577	8579	4289
8/28/1995	0.83	0.83	0.90	0.8	0.8	7154	0.5817	2300.00	283.2	86400	42209	7341	3670
9/27/2004	0.73	0.73	0.90	0.7	0.7	7390	0.6009	165.00	283.2	86400	2663	6456	3228
8/12/2003	0.6	0.6	0.90	0.5	0.5	7743	0.6296	400.00	283.2	86400	5307	5307	2653
7/29/1991	0.4	0.4	0.90	0.4	0.4	8318	0.6764	2000.00	283.2	86400	17688	3538	1769
9/23/2003	0.38	0.38	0.90	0.3	0.3	8399	0.6830	270.00	283.2	86400	2269	3361	1680
9/26/1994	0.35	0.35	0.90	0.3	0.3	8485	0.6899	9800.00	283.2	86400	75839	3095	1548
9/5/1990	0.2	0.2	0.90	0.2	0.2	9211	0.7490	1120.00	283.2	86400	4953	1769	884
10/23/1995	0.19	0.19	0.90	0.2	0.2	9277	0.7544	9800.00	283.2	86400	41170	1680	840
10/1/1991	0	0	0.90	0.0	0.0	10673	0.8679	860.00	283.2	86400	0	0	0
10/27/1992	0	0	0.90	0.0	0.0	10641	0.8653	380.00	283.2	86400	0	0	0

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Appendix I:
Cahokia Canal
Responsiveness Summary

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Appendix I: Cahokia Canal Responsiveness Summary

This responsiveness summary responds to substantive questions and comments received during the public comment period from March 27, 2008 through April 26, 2008 postmarked, including those from the March 27, 2009 public meeting discussed below.

What is a TMDL?

A Total Maximum Daily Load (TMDL) is the sum of the allowable amount of a pollutant that a water body can receive from all contributing sources and still meet water quality standards or designated uses. This TMDL is for the Cahokia Canal watershed. This report details the watershed characteristics, impairment, sources, load and wasteload allocations, and reductions for each segment. The Illinois EPA implements the TMDL program in accordance with Section 303(d) of the federal Clean Water Act and its regulations.

Background

The Cahokia Canal watershed is located in southern Illinois, flows in a southwesterly direction, and drains approximately 181,673 acres within the state of Illinois. Land use in the watershed is 40 percent agriculture, 33 percent urban, 11 percent forest and 8 percent urban open land/wetlands. Assessed waters that are impaired are the Cahokia Canal, Canteen Creek, Harding Ditch and the Frank Holten Lakes. Cahokia Canal is impaired for low dissolved oxygen, Canteen Creek is impaired for manganese and Harding Ditch is impaired for fecal coliform. The lakes are impaired for phosphorus. The Clean Water Act and USEPA regulations require that states develop TMDLs for impaired waters. Horseshoe Lake is in this watershed but will have a separate TMDL document that will include its own responsiveness summary.

Public Meetings

Public meetings were held in Collinsville on June 29, 2006 and March 27, 2008. The Illinois EPA provided public notices for all meetings by placing a display ad in the local newspaper. Public notices were also sent to NPDES dischargers and other stakeholders in the watershed. These notices gave the date, time, location, and purpose of the meetings. It also provided references to obtain additional information about this specific site, the TMDL Program and other related issues. Individuals and organizations were sent the public notice by first class mail. The draft TMDL Report was available for review at the Edwardsville Public Library, the Cahokia Public Library and on the Agency's web page at http://www.epa.state.il.us/water/tmdl .

1. *Failing to provide a clearly defined implementation plan would be antithetical to the goals of the TMDL program. The U.S. EPA, under section303 of the Clean Water Act, has delegated to IEPA the task of conducting TMDL assessments for impaired waters of Illinois in order to develop water criteria and implement them. If the schedule of implementation does not provide a working guide for how to implement the water criteria established, IEPA is not doing its job.*

   Response: The specific goal of the TMDL program (regulated under Section 303(d)) is to provide load allocations for sources. Illinois EPA goes beyond this and provides an implementation plan with general actions that can be taken to reduce the nonpoint source impairment. If this is point source related, permit limits are specified and changes are made at the time of permit renewal or modification. If nonpoint source related, information on best management practices (BMPs) are explained in the plan, but it is difficult to estimate when stakeholders will implement practices in the watershed. Stakeholders are encouraged to form watershed groups and develop a specific plan for implementation at the local level. Illinois EPA can provide technical and financial assistance for plan development.

2. *IEPA has declared: "the need for commitment to the implementation plan by citizens who live/work in the watershed is essential to success in decreasing pollutant loads and improving water quality." While ABC does not disagree with this statement, it believes that only with support from IEPA can citizens be aware of the nature of the problem so that they may learn how to address it. This requires community outreach and education focusing on a sound and clearly defined implementation program. For example, the IEPA should apply for 319 funds to initiate a community awareness program and establish a watershed group in order to bring the goals of the TMDL to fruition. Without such programs, citizens will not be aware of their duties and the TMDL will have been a useless exercise and an enormous waste of time and money. Perhaps the American Bottom Ecosystem partnership group, of which ABC is a member, could serve as the starting point for the watershed group.*

   Response: Illinois EPA can assist any group that is applying for 319 funds. Citizen groups, not-for-profit organizations and educational institutions have developed a variety of projects under the 319 Program. Illinois EPA would welcome action by the American Bottom Ecosystem Partnership Group (ABEPG) or any stakeholders in organizing a watershed group. If anyone is interested in such an endeavor, they should contact Margaret Fertaly at 618/993-7200 in our Marion office. Ms. Fertaly can provide guidance and practical advice on how to go about organizing a watershed group and developing a Watershed Plan.

5. *We are also pleased that IEPA has added Schoenberger Creek/Lansdowne Ditch in the Cahokia Canal Watershed to those bodies of water to be sampled this year. The creek is clearly impaired.*

   Response: Thank you for your comment.

6. *The report states that the maximum amount of pollutant loading to Cahokia Canal may receive without violating water quality standards for oxygen-demanding material is not conclusive. The report sites that in the absence of a reasonable measured calibration data set, model dissolved oxygen forcing variables were adjusted to achieve reasonable values based on limited site specific data and literature/experience. Model internal rates were maintained at default values. Results show that re-aeration dominates over oxidation in the target reach for the assumed loading conditions and kinetic rates.*

   Response: Based on the data for this waterbody, low flow was found to be the cause of low dissolved oxygen in the Cahokia Canal. This water is in a unique situation because it is a flood control waterbody in which there is not a water quality standard that pertains to flood control waters and the general standard applies to this waterbody. In the summer stagnant water sits in the levee system and the absence of canopy cover the temperature level increases.

7. *From the report based on model analysis, flow and reaeration would need to be increased during summer months. Because a TMDL cannot be developed for reaeration, no TMDL will be developed at this time. Further monitoring and implementation measures to increase aeration in the system are discussed. This conclusion from the report, by default, places limits for oxygen demanding material discharged from the WWTP that may not be justified and could require increase capital and operating cost.*

   Response: The TMDL states that no waste load allocations were developed for point sources in this watershed because low flow is the problem. Therefore, no limits were changed for any parameter. The TMDL does show that each point source discharge for CBOD and ammonia are substantially lower than the maximum permitted load. Permit limits for these parameters will remain at the levels currently required by federal and state regulations.

8. *The report fails to recognize that Cahokia Canal is a canal built by the Corps of Engineers for flood control. The canal by design is straight, typically shallow during low flow and does not have trees nearby to provide a canopy for shade. Any restrictions as recommended for re-aeration purposes would limit the streams ability to flow water during flood conditions.*

   Response: While some of the actions proposed to improve water quality in Cahokia Canal may slow flows during extreme flood conditions, the single most important variable, the channelization remains unchanged. Illinois EPA believes that with the careful placement of woody plants and diligent maintenance, the slowing of flows during floods can be held to a minimum.

9. *The City would like to pursue options to make sure we are investing the public's money wisely and with justification. Options include a water quality study of the stream and investigating the proper water use classification of the canal and possibly seeking a revision.*

Response: In order to change the designated use of a waterbody, a Use Attainability Analysis (UAA) would have to be completed and approved. There is nothing in this TMDL that would prevent the City from pursuing this option.

10. *Collinsville does not want to be persecuted because Cahokia Canal has been built for flooding purposes. In some instances flood control takes precedence over water quality. Is a UAA an option for this waterbody?*

    Response: As pointed out by stakeholders, the canal is being used for fishing and full body contact. There are also construction activities that may have effects on the canal. If Collinsville decides to pursue a UAA, it will have to take all factors/standards into consideration.

Appendix J:
BATHTUB
Frank Holten Lakes

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Frank Holten Lakes
BATHTUB Modeling Parameter Development

Frank Holten Lakes

Segment ID	Monitoring Station	Wet Obs Total P (ppb)	Dry Obs Total P (ppb)	Surface Area (acres	Mean Depth (ft)	Length (ft)	ibutary Area (acre	Surface Area(sq km)	Mean Depth (m)	Length (km)
1	RJK-1	166.54	267.27	42	13.0	3,160	1,806	0.17	4.0	0.96
2	RJL-1	116.25	131.37	31	21.2	2,130	314	0.13	6.5	0.65
3	RJM-1 & RJM-2	144.49	148.82	31	7.8	2,500	730	0.12	2.4	0.76
4	RJM-3	138.75	184.72	55	6.1	2,140	342	0.22	1.9	0.65
							3192.8			

			Segment ID			Flow (hm^3/yr), h=million			Total P Concentration (ppb)				
Tributary ID	**Tributary Area (sq km)**	**Weighted C-Coeff**	**Dry**	**Wet**	**Fall/Winter**	**Dry (July-August)***	**Wet (March-May)**	**Fall/Winter**	**Dry (July-August)***	**Wet (March-May)**	**Wet CV**		
1	7.3	0.38	1	1		2.59	3.27		290.77	290.77	0.90		
2	1.3	0.43	2	2		0.51	0.64		170.32	170.32	1.00		
3	3.0	0.47	3	3		1.30	1.64		207.80	207.80	0.83		
4	1.4	0.72	4	4		0.93	1.18		59.08	59.08	0.52		
Harding Ditch (5)				4			41.6			439.05			
									727.97	1167.02			

Calculated in Horsehoe_LU.xls

Tributary ID	Area_acres (GIS)
1	1848
2	346
3	760
4	397

Report

Tributary ID	Area (sq mi)	Dry Flow (cfs)	Wet Flow (cfs)
1	2.8	2.9	3.7
2	0.5	0.6	0.7
3	1.1	1.5	1.8
4	0.5	1.0	1.3
Harding Ditch (5)	41.0	0.0	46.6
total	46.0	6.0	54.1

Rainfall

Source: Stage 1 Report

Month	Total Precipitation (inches)	Maximum Temperature (degrees F)	Minimum Temperature (degrees F)
January	2.1	39	20
February	2.3	45	25
March	3.6	56	34
April	4.0	68	45
May	4.0	76	54
June	3.8	85	63
July	3.8	89	67
August	3.6	87	65
September	3.1	80	57
October	2.7	70	45
November	3.5	56	35
December	2.7	44	26
Total	39.2		

	Average Precipitation (inches)	**Total Precipitation (meters)**	**Total Precipitation (inches)**
Dry (Other Months)	3.1	0.7010	27.60
Wet (March-May)	3.9	0.2946	11.60

Evaporation

http://www.sws.uiuc.edu/atmos/statecli/pan_evap/panevap.htm

Month	Evaporation (inches)
April	#VALUE!
May	5.1
June	5.9
July	6.1
August	5.3
September	4.1
	27

	Average Evaporation (inches)	**Total Evaporation (meters)**	**Total Evaporation (inches)**
Dry (Other Months)	5.3	0.5429	21.4
Wet (March-May)	5.1	0.1307	5.1

Estimated Harding Ditch Monthly Flow

source??

Month	Flow (cfs)
Jan	37
Feb	40
Mar	44
Apr	50
May	46
Jun	33
Jul	21
Aug	13
Sep	8
Oct	8
Nov	21
Dec	29

	Mean Flow (cfs)
Wet (March-May)	46.6

Harding Ditch Total P Data (JMAC02)
Calculated in HardingDitch-P.xls

Month	Total Phosphorous (mg/L)
January	0.41
February	0.37
March	0.32
April	0.53
May	0.47
June	0.43
July	0.46
August	0.51
September	1.14
October	0.74
November	0.70
December	0.44

	Total P (mg/L)
Wet (March-May)	0.439

Model Averaging Periods

Scenario	Months	Fraction of Year
Dry	All Other Months	0.75
Wet	March-May	0.25

Observed Total Phosphorous Data (mg/L)

Month	RJK-1	RJL-1	RJM-1	RJM-2	RJM-3
January	0.10	0.15	0.11	0.20	0.20
February	0.16	0.10	0.11	0.11	0.14
March	0.18	0.11	0.17	0.09	0.12
April	0.17	0.11	0.13	0.12	0.13
May	0.15	0.13	0.18	0.17	0.17
June	0.13	0.13	0.14	0.15	0.22
July	0.16	0.13	0.19	0.18	0.24
August	0.26	0.16	0.21	0.18	0.21
September	0.43	0.20	0.13	0.14	
October	0.31	0.14	0.13	0.14	0.17
November	0.37	0.08	0.17	0.15	0.16
December	0.50	0.08	0.12	0.13	0.13
Wet (March-May)	0.17	0.12	0.16	0.13	0.14
Dry (Other Months)	0.27	0.13	0.14	0.15	0.18

Legend

Used to develop parameters for Wet model
Used to develop parameters for Dry model
Calculated from flow, WQ data
Model Input
Global Model Input

Frank Holten Lakes
Dry Weather Scenario- Existing Conditions
BATHTUB Modeling Files

Frank Holten Lakes- Dry
File: **E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\FrankHolt**

Segment & Tributary Network

--------Segment:	1	1- Frank Holten Lake 1	
Outflow Segment:	2	2- Frank Holten Lake 2	
Tributary:	1	1- Trib 1	Type: Non Point Inflow
--------Segment:	2	2- Frank Holten Lake 2	
Outflow Segment:	3	3- Frank Holten Lake 3- North	
Tributary:	2	2- Trib 2	Type: Non Point Inflow
--------Segment:	3	3- Frank Holten Lake 3- North	
Outflow Segment:	4	4- Frank Holten Lake 3- South	
Tributary:	3	3- Trib 3	Type: Non Point Inflow
--------Segment:	4	4- Frank Holten Lake 3- South	
Outflow Segment:	0	Out of Reservoir	
Tributary:	4	4- Trib 4	Type: Non Point Inflow

Frank Holten Lakes- Dry
File: **E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\FrankHoltenLks_DryCAL.btb**
Description:
Frank Holten Lakes during all months except March-May

Global Variables	Mean	CV
Averaging Period (yrs)	0.75	0.0
Precipitation (m)	0.701	0.0
Evaporation (m)	0.5429	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Model Options	Code	Description
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	1	2ND ORDER, AVAIL P
Nitrogen Balance	0	NOT COMPUTED
Chlorophyll-a	2	P, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	1	FISCHER-NUMERIC
Phosphorus Calibration	1	DECAY RATES
Nitrogen Calibration	1	DECAY RATES
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

Segment Morphometry

		Outflow		Area	Depth	Length	Mixed Depth (m)		Hypol Depth		Non-Algal Turb (m^{-1})		Internal Loads (mg/m2-day) Conserv.		Total P		Total N	
Seg	Name	Segment	Group	km^2	m	km	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	1- Frank Holten Lake 1	2	1	0.17	4	0.96	4	0	0	0	0.08	0.2	0	0	2.75	0	0	0
2	2- Frank Holten Lake 2	3	2	0.13	6.5	0.65	6.5	0	0	0	0.08	0.2	0	0	1.25	0	0	0
3	3- Frank Holten Lake 3- North	4	3	0.12	2.4	0.76	2.4	0	0	0	0.08	0.2	0	0	1.25	0	0	0
4	4- Frank Holten Lake 3- South	0	3	0.22	1.9	0.65	1.9	0	0	0	0.08	0.2	0	0	1.25	0	0	0

Segment Observed Water Quality

	Conserv		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)		Organic N (ppb)		TP - Ortho P (ppb)		HOD (ppb/day)		MOD (ppb/day)	
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	0	0	267.27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	131.37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	148.82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	184.72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Segment Calibration Factors

	Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)		Organic N (ppb)		TP - Ortho P (ppb)		HOD (ppb/day)		MOD (ppb/day)	
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
2	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
3	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
4	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0

Tributary Data

				Dr Area	Flow (hm^3/yr)		Conserv.		Total P (ppb)		Total N (ppb)		Ortho P (ppb)		Inorganic N (ppb)	
Trib	Trib Name	Segment	Type	km^2	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	1- Trib 1	1	2	7.3	2.59	0.1	0	0	290.77	0.9	0	0	0	0	0	0
2	2- Trib 2	2	2	1.3	0.51	0.1	0	0	170.32	1	0	0	0	0	0	0
3	3- Trib 3	3	2	3	1.3	0.1	0	0	207.8	0.83	0	0	0	0	0	0
4	4- Trib 4	4	2	1.4	0.93	0.1	0	0	59.08	0.52	0	0	0	0	0	0

Model Coefficients	Mean	CV
Dispersion Rate	1.000	0.70
Total Phosphorus	1.000	0.45
Total Nitrogen	1.000	0.55
Chl-a Model	1.000	0.26
Secchi Model	1.000	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Frank Holten Lakes- Dry
File: **E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\Fra**

Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: 5 Area-Wtd Mean

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	201.8	0.21	94.5%	189.1		93.6%
CHL-A MG/M3	55.3	0.27	98.9%			
SECCHI M	0.8	0.26	34.1%			
ORGANIC N MG/M3	1423.7	0.27	98.4%			
TP-ORTHO-P MG/M3	96.2	0.31	89.0%			
ANTILOG PC-1	2109.2	0.51	95.0%			
ANTILOG PC-2	15.1	0.08	94.7%			
TURBIDITY 1/M	0.1	0.10	1.1%	0.1	0.10	1.1%
ZMIX * TURBIDITY	0.3	0.11	0.1%	0.3	0.11	0.1%
ZMIX / SECCHI	4.3	0.27	42.3%			
CHL-A * SECCHI	37.5	0.10	96.7%			
CHL-A / TOTAL P	0.3	0.30	70.7%			
FREQ(CHL-a>10) %	97.1	0.02	98.9%			
FREQ(CHL-a>20) %	83.9	0.10	98.9%			
FREQ(CHL-a>30) %	68.0	0.18	98.9%			
FREQ(CHL-a>40) %	53.7	0.25	98.9%			
FREQ(CHL-a>50) %	41.9	0.33	98.9%			
FREQ(CHL-a>60) %	32.7	0.40	98.9%			
CARLSON TSI-P	80.5	0.04	94.5%	79.2		93.6%
CARLSON TSI-CHLA	69.2	0.04	98.9%			
CARLSON TSI-SEC	64.5	0.06	65.9%			

Segment: 1 1- Frank Holten Lake 1

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	246.8	0.21	96.6%	267.3		97.2%
CHL-A MG/M3	43.6	0.26	97.7%			
SECCHI M	0.9	0.26	37.9%			
ORGANIC N MG/M3	1158.1	0.26	96.0%			
TP-ORTHO-P MG/M3	75.5	0.31	83.4%			
ANTILOG PC-1	1242.5	0.49	89.2%			
ANTILOG PC-2	15.3	0.08	95.0%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.3	0.20	0.2%	0.3	0.20	0.2%
ZMIX / SECCHI	4.7	0.26	48.8%			
CHL-A * SECCHI	37.3	0.10	96.6%			
CHL-A / TOTAL P	0.2	0.31	43.6%			
FREQ(CHL-a>10) %	98.1	0.02	97.7%			
FREQ(CHL-a>20) %	82.9	0.13	97.7%			
FREQ(CHL-a>30) %	61.6	0.26	97.7%			
FREQ(CHL-a>40) %	43.3	0.38	97.7%			
FREQ(CHL-a>50) %	29.8	0.49	97.7%			
FREQ(CHL-a>60) %	20.5	0.59	97.7%			

CARLSON TSI-P	83.6	0.04	96.6%	84.7		97.2%
CARLSON TSI-CHLA	67.6	0.04	97.7%			
CARLSON TSI-SEC	62.3	0.06	62.1%			

Segment: 2 2- Frank Holten Lake 2

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	165.7	0.25	91.6%	131.4		86.9%
CHL-A MG/M3	25.7	0.26	90.5%			
SECCHI M	1.4	0.25	62.7%			
ORGANIC N MG/M3	749.6	0.24	81.6%			
TP-ORTHO-P MG/M3	43.6	0.32	65.3%			
ANTILOG PC-1	480.1	0.48	69.6%			
ANTILOG PC-2	15.6	0.08	95.4%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.5	0.20	1.0%	0.5	0.20	1.0%
ZMIX / SECCHI	4.7	0.25	49.0%			
CHL-A * SECCHI	35.6	0.11	96.1%			
CHL-A / TOTAL P	0.2	0.33	35.7%			
FREQ(CHL-a>10) %	88.8	0.09	90.5%			
FREQ(CHL-a>20) %	53.8	0.31	90.5%			
FREQ(CHL-a>30) %	28.8	0.50	90.5%			
FREQ(CHL-a>40) %	15.3	0.66	90.5%			
FREQ(CHL-a>50) %	8.3	0.80	90.5%			
FREQ(CHL-a>60) %	4.7	0.91	90.5%			
CARLSON TSI-P	77.8	0.05	91.6%	74.5		86.9%
CARLSON TSI-CHLA	62.5	0.04	90.5%			
CARLSON TSI-SEC	55.3	0.07	37.3%			

Segment: 3 3- Frank Holten Lake 3- North

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	178.3	0.22	92.8%	148.8		89.6%
CHL-A MG/M3	62.4	0.27	99.3%			
SECCHI M	0.6	0.27	22.6%			
ORGANIC N MG/M3	1584.9	0.27	99.1%			
TP-ORTHO-P MG/M3	108.8	0.32	91.2%			
ANTILOG PC-1	2384.8	0.51	95.9%			
ANTILOG PC-2	14.9	0.08	94.6%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.2	0.20	0.0%	0.2	0.20	0.0%
ZMIX / SECCHI	3.9	0.28	37.0%			
CHL-A * SECCHI	38.0	0.10	96.9%			
CHL-A / TOTAL P	0.3	0.30	81.9%			
FREQ(CHL-a>10) %	99.6	0.01	99.3%			
FREQ(CHL-a>20) %	93.6	0.06	99.3%			
FREQ(CHL-a>30) %	80.8	0.14	99.3%			
FREQ(CHL-a>40) %	65.8	0.24	99.3%			
FREQ(CHL-a>50) %	51.9	0.33	99.3%			
FREQ(CHL-a>60) %	40.2	0.42	99.3%			
CARLSON TSI-P	78.9	0.04	92.8%	76.3		89.6%

CARLSON TSI-CHLA	71.1	0.04	99.3%
CARLSON TSI-SEC	67.1	0.06	77.4%

Segment: 4 4- Frank Holten Lake 3- South

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	201.0	0.20	94.4%	184.7		93.3%
CHL-A MG/M3	77.9	0.27	99.7%			
SECCHI M	0.5	0.27	15.1%			
ORGANIC N MG/M3	1939.2	0.28	99.7%			
TP-ORTHO-P MG/M3	136.5	0.31	94.5%			
ANTILOG PC-1	3591.3	0.51	98.0%			
ANTILOG PC-2	14.7	0.08	94.2%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.2	0.20	0.0%	0.2	0.20	0.0%
ZMIX / SECCHI	3.9	0.28	35.7%			
CHL-A * SECCHI	38.4	0.10	96.9%			
CHL-A / TOTAL P	0.4	0.29	85.8%			
FREQ(CHL-a>10) %	99.9	0.00	99.7%			
FREQ(CHL-a>20) %	97.0	0.03	99.7%			
FREQ(CHL-a>30) %	89.1	0.09	99.7%			
FREQ(CHL-a>40) %	77.8	0.16	99.7%			
FREQ(CHL-a>50) %	65.7	0.24	99.7%			
FREQ(CHL-a>60) %	54.4	0.31	99.7%			
CARLSON TSI-P	80.6	0.04	94.4%	79.4		93.3%
CARLSON TSI-CHLA	73.3	0.04	99.7%			
CARLSON TSI-SEC	70.2	0.06	84.9%			

Frank Holten Lakes- Dry
File: E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\FrankHoltenLks_DryCAL.btb

Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 0.75 years**

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance $(hm3/yr)^2$	CV -	Runoff m/yr
			PRECIPITATION	0.6	0.6	0.00E+00	0.00	0.93
			***TOTAL INFLOW	13.6	0.6	0.00E+00	0.00	0.04
			ADVECTIVE OUTFLOW	13.6	0.1	0.00E+00	0.00	0.01
			***TOTAL OUTFLOW	13.6	0.1	0.00E+00	0.00	0.01
			***EVAPORATION		0.5	0.00E+00	0.00	

Overall Mass Balance Based Upon Component: **Predicted TOTAL P** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	%Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
			PRECIPITATION	19.2	4.7%	9.22E+01	100.0%	0.50	32.1	30.0
			INTERNAL LOAD	385.3	95.3%	0.00E+00		0.00		
			***TOTAL INFLOW	404.5	100.0%	9.22E+01	100.0%	0.02	676.3	29.7
			ADVECTIVE OUTFLOW	27.1	6.7%	3.07E+01		0.20	201.0	2.0
			***TOTAL OUTFLOW	27.1	6.7%	3.07E+01		0.20	201.0	2.0
			***RETENTION	377.4	93.3%	1.15E+02		0.03		

Overflow Rate (m/yr)	0.2	Nutrient Resid. Time (yrs)	1.1127
Hydraulic Resid. Time (yrs)	16.5367	Turnover Ratio	0.7
Reservoir Conc (mg/m3)	202	Retention Coef.	0.933

Frank Holten Lakes- Dry
File: E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\FrankHoltenLks_DryCAL.btb

Hydraulic & Dispersion Parameters

Seg	Name	Outflow Seg	Net Inflow hm^3/yr	Resid Time years	Overflow Rate m/yr	Velocity km/yr	Dispersion--------> Estimated km^2/yr	Numeric km^2/yr	Exchange hm^3/yr
1	1- Frank Holten Lake 1	2	0.0	18.9753	0.2	1.0	1.0	0.0	0.7
2	2- Frank Holten Lake 2	3	0.1	13.3618	0.5	1.0	0.8	0.0	1.6
3	3- Frank Holten Lake 3- No	4	0.1	3.2529	0.7	1.0	1.2	0.1	0.6
4	4- Frank Holten Lake 3- So	0	0.1	3.0983	0.6	1.0	6.7	0.1	0.0

Morphometry

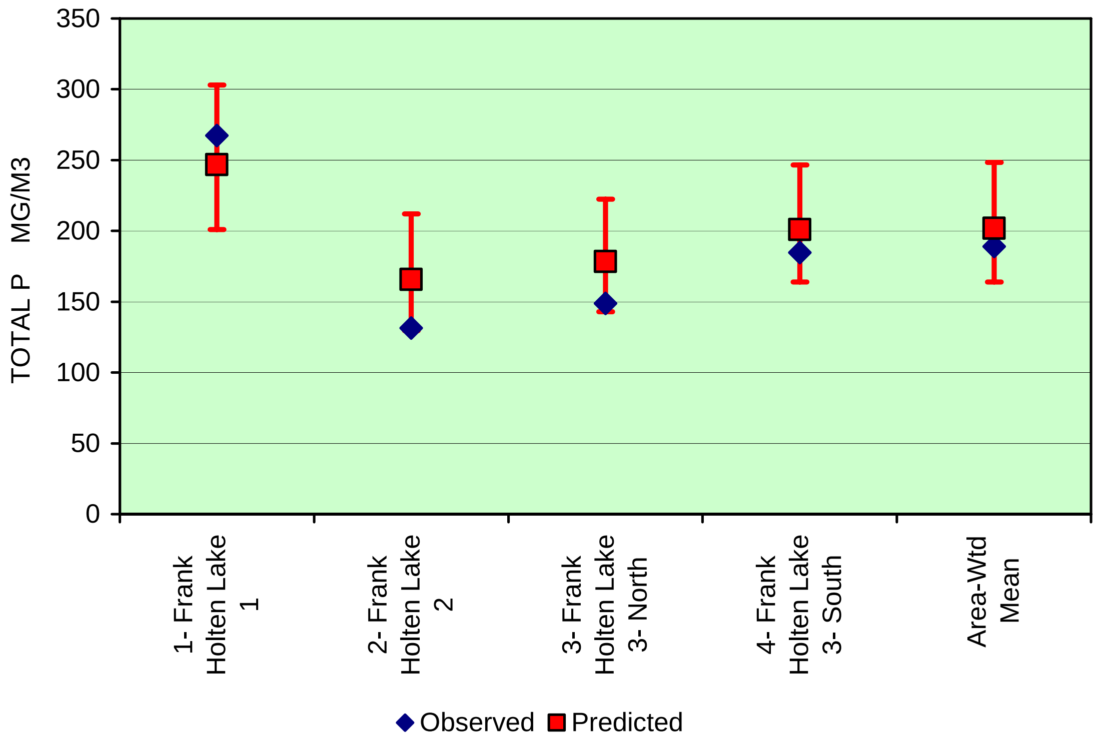
Seg	Name	Area km^2	Zmean m	Zmix m	Length km	Volume hm^3	Width km	L/W -
1	1- Frank Holten Lake 1	0.2	4.0	4.0	1.0	0.7	0.2	5.4
2	2- Frank Holten Lake 2	0.1	6.5	6.5	0.6	0.8	0.2	3.2
3	3- Frank Holten Lake 3- No	0.1	2.4	2.4	0.8	0.3	0.2	4.8
4	4- Frank Holten Lake 3- So	0.2	1.9	1.9	0.6	0.4	0.3	1.9
Totals		0.6	3.5			2.2		

Frank Holten Lakes- Dry

File: E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\Fra

Variable: TOTAL P MG/M3

Segment	Predicted Mean	CV	Observed Mean	CV
1- Frank Holten Lake 1	246.8	0.21	267.3	0.00
2- Frank Holten Lake 2	165.7	0.25	131.4	0.00
3- Frank Holten Lake 3- Nor	178.3	0.22	148.8	0.00
4- Frank Holten Lake 3- Sou	201.0	0.20	184.7	0.00
Area-Wtd Mean	201.8	0.21	189.1	0.00



Frank Holten Lakes
Dry Weather Scenario- Reduced Loading Conditions
BATHTUB Modeling Files

Frank Holten Lakes- Dry
File: **E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\Frankl**

Segment & Tributary Network

--------Segment:	1	1- Frank Holten Lake 1		
Outflow Segment:	2	2- Frank Holten Lake 2		
Tributary:	1	1- Trib 1	Type:	Non Point Inflow
--------Segment:	2	2- Frank Holten Lake 2		
Outflow Segment:	3	3- Frank Holten Lake 3- North		
Tributary:	2	2- Trib 2	Type:	Non Point Inflow
--------Segment:	3	3- Frank Holten Lake 3- North		
Outflow Segment:	4	4- Frank Holten Lake 3- South		
Tributary:	3	3- Trib 3	Type:	Non Point Inflow
--------Segment:	4	4- Frank Holten Lake 3- South		
Outflow Segment:	0	Out of Reservoir		
Tributary:	4	4- Trib 4	Type:	Non Point Inflow

Frank Holten Lakes- Dry
File: **E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\FrankHoltenLks_DryRED.btb**
Description:
Frank Holten Lakes during all months except March-May

Global Variables	Mean	CV
Averaging Period (yrs)	0.75	0.0
Precipitation (m)	0.701	0.0
Evaporation (m)	0.5429	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Model Options	Code	Description
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	1	2ND ORDER, AVAIL P
Nitrogen Balance	0	NOT COMPUTED
Chlorophyll-a	2	P, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	1	FISCHER-NUMERIC
Phosphorus Calibration	1	DECAY RATES
Nitrogen Calibration	1	DECAY RATES
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

Segment Morphometry

		Outflow		Area	Depth	Length	Mixed Depth (m)		Hypol Depth		Non-Algal Turb (m^{-1})		Internal Loads (mg/m2-day) Conserv.		Total P		Total N	
Seq	Name	Segment	Group	km^2	m	km	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	1- Frank Holten Lake 1	2	1	0.17	4	0.96	4	0	0	0	0.08	0.2	0	0	0.06	0	0	0
2	2- Frank Holten Lake 2	3	2	0.13	6.5	0.65	6.5	0	0	0	0.08	0.2	0	0	0.06	0	0	0
3	3- Frank Holten Lake 3- North	4	3	0.12	2.4	0.76	2.4	0	0	0	0.08	0.2	0	0	0.06	0	0	0
4	4- Frank Holten Lake 3- South	0	4	0.22	1.9	0.65	1.9	0	0	0	0.08	0.2	0	0	0.06	0	0	0

Segment Observed Water Quality

	Conserv		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)		Organic N (ppb)		TP - Ortho P (ppb)		HOD (ppb/day)		MOD (ppb/day)	
Seq	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	0	0	267.27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	131.37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	148.82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	184.72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Segment Calibration Factors

	Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)		Organic N (ppb)		TP - Ortho P (ppb)		HOD (ppb/day)		MOD (ppb/day)	
Seq	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
2	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
3	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
4	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0

Tributary Data

				Dr Area	Flow (hm^3/yr)		Conserv.		Total P (ppb)		Total N (ppb)		Ortho P (ppb)		Inorganic N (ppb)	
Trib	Trib Name	Segment	Type	km^2	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	1- Trib 1	1	2	7.3	2.59	0.1	0	0	0	0.9	0	0	0	0	0	0
2	2- Trib 2	2	2	1.3	0.51	0.1	0	0	0	1	0	0	0	0	0	0
3	3- Trib 3	3	2	3	1.3	0.1	0	0	0	0.83	0	0	0	0	0	0
4	4- Trib 4	4	2	1.4	0.93	0.1	0	0	0	0.52	0	0	0	0	0	0

Model Coefficients	Mean	CV
Dispersion Rate	1.000	0.70
Total Phosphorus	1.000	0.45
Total Nitrogen	1.000	0.55
Chl-a Model	1.000	0.26
Secchi Model	1.000	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Frank Holten Lakes- Dry

File: **E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\Fra**

Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: 5 Area-Wtd Mean

Variable	Predicted Values---> Mean	CV	Rank	Observed Values---> Mean	CV	Rank
TOTAL P MG/M3	46.9	0.25	49.1%	189.1		93.6%
CHL-A MG/M3	23.8	0.34	88.7%			
SECCHI M	1.5	0.30	67.9%			
ORGANIC N MG/M3	706.6	0.29	78.3%			
TP-ORTHO-P MG/M3	40.2	0.39	62.1%			
ANTILOG PC-1	433.0	0.62	66.8%			
ANTILOG PC-2	15.6	0.08	95.4%			
TURBIDITY 1/M	0.1	0.10	1.1%	0.1	0.10	1.1%
ZMIX * TURBIDITY	0.3	0.11	0.1%	0.3	0.11	0.1%
ZMIX / SECCHI	2.1	0.30	8.5%			
CHL-A * SECCHI	35.1	0.11	95.9%			
CHL-A / TOTAL P	0.5	0.26	93.2%			
FREQ(CHL-a>10) %	83.8	0.14	88.7%			
FREQ(CHL-a>20) %	47.7	0.42	88.7%			
FREQ(CHL-a>30) %	25.1	0.66	88.7%			
FREQ(CHL-a>40) %	13.3	0.86	88.7%			
FREQ(CHL-a>50) %	7.3	1.03	88.7%			
FREQ(CHL-a>60) %	4.1	1.17	88.7%			
CARLSON TSI-P	59.6	0.06	49.1%	79.2		93.6%
CARLSON TSI-CHLA	61.5	0.05	88.7%			
CARLSON TSI-SEC	54.1	0.08	32.1%			

Segment: 1 1- Frank Holten Lake 1

Variable	Predicted Values---> Mean	CV	Rank	Observed Values---> Mean	CV	Rank
TOTAL P MG/M3	48.4	0.25	50.5%	267.3		97.2%
CHL-A MG/M3	21.9	0.32	86.4%			
SECCHI M	1.6	0.30	69.5%			
ORGANIC N MG/M3	662.6	0.27	74.4%			
TP-ORTHO-P MG/M3	36.8	0.37	58.5%			
ANTILOG PC-1	361.4	0.58	61.7%			
ANTILOG PC-2	15.6	0.08	95.4%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.3	0.20	0.2%	0.3	0.20	0.2%
ZMIX / SECCHI	2.5	0.30	13.5%			
CHL-A * SECCHI	34.9	0.11	95.9%			
CHL-A / TOTAL P	0.5	0.27	90.6%			
FREQ(CHL-a>10) %	83.0	0.16	86.4%			
FREQ(CHL-a>20) %	43.5	0.47	86.4%			
FREQ(CHL-a>30) %	20.7	0.72	86.4%			
FREQ(CHL-a>40) %	10.0	0.92	86.4%			
FREQ(CHL-a>50) %	5.0	1.09	86.4%			
FREQ(CHL-a>60) %	2.7	1.23	86.4%			

CARLSON TSI-P	60.1	0.06	50.5%	84.7		97.2%
CARLSON TSI-CHLA	60.9	0.05	86.4%			
CARLSON TSI-SEC	53.3	0.08	30.5%			

Segment: 2 2- Frank Holten Lake 2

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	44.3	0.26	46.6%	131.4		86.9%
CHL-A MG/M3	15.7	0.31	74.8%			
SECCHI M	2.1	0.27	81.2%			
ORGANIC N MG/M3	520.8	0.24	57.3%			
TP-ORTHO-P MG/M3	25.7	0.37	43.6%			
ANTILOG PC-1	201.9	0.54	44.1%			
ANTILOG PC-2	15.6	0.08	95.4%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.5	0.20	1.0%	0.5	0.20	1.0%
ZMIX / SECCHI	3.1	0.27	22.4%			
CHL-A * SECCHI	33.2	0.12	95.2%			
CHL-A / TOTAL P	0.4	0.28	82.4%			
FREQ(CHL-a>10) %	66.2	0.27	74.8%			
FREQ(CHL-a>20) %	24.2	0.64	74.8%			
FREQ(CHL-a>30) %	8.8	0.91	74.8%			
FREQ(CHL-a>40) %	3.4	1.12	74.8%			
FREQ(CHL-a>50) %	1.5	1.29	74.8%			
FREQ(CHL-a>60) %	0.7	1.43	74.8%			
CARLSON TSI-P	58.8	0.06	46.6%	74.5		86.9%
CARLSON TSI-CHLA	57.6	0.05	74.8%			
CARLSON TSI-SEC	49.2	0.08	18.8%			

Segment: 3 3- Frank Holten Lake 3- North

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	45.2	0.26	47.4%	148.8		89.6%
CHL-A MG/M3	25.5	0.36	90.3%			
SECCHI M	1.4	0.33	63.1%			
ORGANIC N MG/M3	744.4	0.30	81.2%			
TP-ORTHO-P MG/M3	43.2	0.40	64.9%			
ANTILOG PC-1	472.6	0.64	69.2%			
ANTILOG PC-2	15.6	0.08	95.4%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.2	0.20	0.0%	0.2	0.20	0.0%
ZMIX / SECCHI	1.7	0.33	4.0%			
CHL-A * SECCHI	35.5	0.11	96.1%			
CHL-A / TOTAL P	0.6	0.26	95.2%			
FREQ(CHL-a>10) %	88.5	0.12	90.3%			
FREQ(CHL-a>20) %	53.3	0.43	90.3%			
FREQ(CHL-a>30) %	28.4	0.69	90.3%			
FREQ(CHL-a>40) %	15.0	0.90	90.3%			
FREQ(CHL-a>50) %	8.1	1.07	90.3%			
FREQ(CHL-a>60) %	4.5	1.22	90.3%			
CARLSON TSI-P	59.1	0.06	47.4%	76.3		89.6%

CARLSON TSI-CHLA	62.4	0.06	90.3%			
CARLSON TSI-SEC	55.2	0.09	36.9%			

Segment: 4 4- Frank Holten Lake 3- South

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	48.2	0.25	50.3%	184.7		93.3%
CHL-A MG/M3	29.2	0.36	93.0%			
SECCHI M	1.2	0.34	56.9%			
ORGANIC N MG/M3	829.8	0.31	86.4%			
TP-ORTHO-P MG/M3	49.9	0.41	70.4%			
ANTILOG PC-1	603.4	0.66	75.4%			
ANTILOG PC-2	15.5	0.08	95.3%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.2	0.20	0.0%	0.2	0.20	0.0%
ZMIX / SECCHI	1.5	0.34	2.6%			
CHL-A * SECCHI	36.1	0.11	96.3%			
CHL-A / TOTAL P	0.6	0.26	96.2%			
FREQ(CHL-a>10) %	92.2	0.09	93.0%			
FREQ(CHL-a>20) %	61.9	0.35	93.0%			
FREQ(CHL-a>30) %	36.3	0.60	93.0%			
FREQ(CHL-a>40) %	20.7	0.80	93.0%			
FREQ(CHL-a>50) %	12.0	0.98	93.0%			
FREQ(CHL-a>60) %	7.1	1.12	93.0%			
CARLSON TSI-P	60.0	0.06	50.3%	79.4		93.3%
CARLSON TSI-CHLA	63.7	0.06	93.0%			
CARLSON TSI-SEC	57.0	0.09	43.1%			

Frank Holten Lakes- Dry
File: E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\FrankHoltenLks_DryRED.btb

Overall Water & Nutrient Balances

Overall Water Balance — Averaging Period = 0.75 years

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance $(hm3/yr)^2$	CV -	Runoff m/yr
			PRECIPITATION	0.6	0.6	0.00E+00	0.00	0.93
			***TOTAL INFLOW	13.6	0.6	0.00E+00	0.00	0.04
			ADVECTIVE OUTFLOW	13.6	0.1	0.00E+00	0.00	0.01
			***TOTAL OUTFLOW	13.6	0.1	0.00E+00	0.00	0.01
			***EVAPORATION		0.5	0.00E+00	0.00	

Overall Mass Balance Based Upon — Predicted — Outflow & Reservoir Concentrations
Component: — TOTAL P

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	%Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
			PRECIPITATION	19.2	57.8%	9.22E+01	100.0%	0.50	32.1	30.0
			INTERNAL LOAD	14.0	42.2%	0.00E+00		0.00		
			***TOTAL INFLOW	33.2	100.0%	9.22E+01	100.0%	0.29	55.5	2.4
			ADVECTIVE OUTFLOW	6.5	19.6%	2.67E+00		0.25	48.2	0.5
			***TOTAL OUTFLOW	6.5	19.6%	2.67E+00		0.25	48.2	0.5
			***RETENTION	26.7	80.4%	7.44E+01		0.32		

Overflow Rate (m/yr)	0.2	Nutrient Resid. Time (yrs)	3.1496
Hydraulic Resid. Time (yrs)	16.5367	Turnover Ratio	0.2
Reservoir Conc (mg/m3)	47	Retention Coef.	0.804

Frank Holten Lakes- Dry
File: E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\FrankHoltenLks_DryRED.btb

Hydraulic & Dispersion Parameters

Seg	Name	Outflow Seg	Net Inflow hm³/yr	Resid Time years	Overflow Rate m/yr	Velocity km/yr	Dispersion--------> Estimated km²/yr	Numeric km²/yr	Exchange hm³/yr
1	1- Frank Holten Lake 1	2	0.0	18.9753	0.2	1.0	1.0	0.0	0.7
2	2- Frank Holten Lake 2	3	0.1	13.3618	0.5	1.0	0.8	0.0	1.6
3	3- Frank Holten Lake 3- North	4	0.1	3.2529	0.7	1.0	1.2	0.1	0.6
4	4- Frank Holten Lake 3- South	0	0.1	3.0983	0.6	1.0	6.7	0.1	0.0

Morphometry

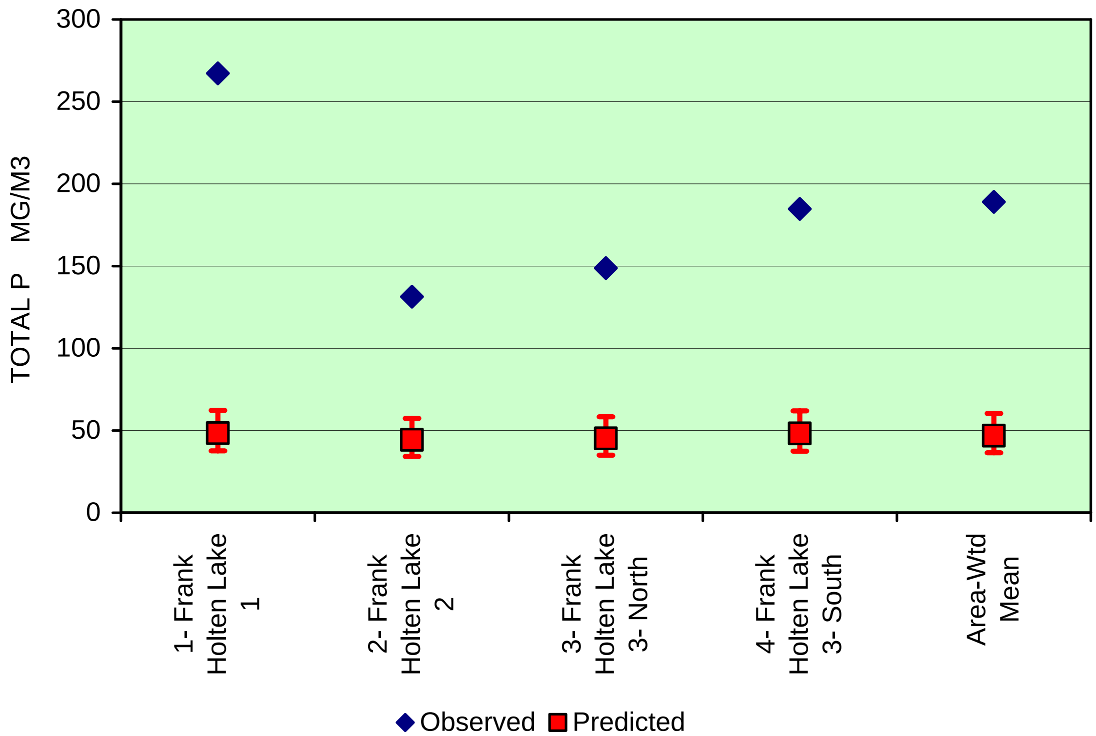
Seg	Name	Area km²	Zmean m	Zmix m	Length km	Volume hm³	Width km	L/W -
1	1- Frank Holten Lake 1	0.2	4.0	4.0	1.0	0.7	0.2	5.4
2	2- Frank Holten Lake 2	0.1	6.5	6.5	0.6	0.8	0.2	3.2
3	3- Frank Holten Lake 3- North	0.1	2.4	2.4	0.8	0.3	0.2	4.8
4	4- Frank Holten Lake 3- South	0.2	1.9	1.9	0.6	0.4	0.3	1.9
Totals		0.6	3.5			2.2		

Frank Holten Lakes- Dry

File: **E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\Fra**

Variable: **TOTAL P MG/M3**

	Predicted		Observed	
Segment	**Mean**	**CV**	**Mean**	**CV**
1- Frank Holten Lake 1	48.4	0.25	267.3	0.00
2- Frank Holten Lake 2	44.3	0.26	131.4	0.00
3- Frank Holten Lake 3- North	45.2	0.26	148.8	0.00
4- Frank Holten Lake 3- South	48.2	0.25	184.7	0.00
Area-Wtd Mean	46.9	0.25	189.1	0.00



Frank Holten Lakes
Wet Weather Scenario- Existing Conditions
BATHTUB Modeling Files

Frank Holten Lakes- Wet
File: **E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\Frank**

Segment & Tributary Network

--------Segment:	1	1- Frank Holten Lake 1		
Outflow Segment:	2	2- Frank Holten Lake 2		
Tributary:	1	1- Trib 1	Type:	Non Point Inflow
--------Segment:	2	2- Frank Holten Lake 2		
Outflow Segment:	3	3- Frank Holten Lake 3- North		
Tributary:	2	2- Trib 2	Type:	Non Point Inflow
--------Segment:	3	3- Frank Holten Lake 3- North		
Outflow Segment:	4	4- Frank Holten Lake 3- South		
Tributary:	3	3- Trib 3	Type:	Non Point Inflow
--------Segment:	4	4- Frank Holten Lake 3- South		
Outflow Segment:	0	Out of Reservoir		
Tributary:	4	4- Trib 4	Type:	Non Point Inflow
Tributary:	5	5- Harding Ditch	Type:	Monitored Inflow

Frank Holten Lakes- Wet
File: **E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\FrankHoltenLks_WetCAL.btb**
Description:
March-May

Global Variables	Mean	CV
Averaging Period (yrs)	0.25	0.0
Precipitation (m)	0.2946	0.0
Evaporation (m)	0.1307	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Model Options	Code	Description
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	1	2ND ORDER, AVAIL P
Nitrogen Balance	0	NOT COMPUTED
Chlorophyll-a	2	P, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	1	FISCHER-NUMERIC
Phosphorus Calibration	1	DECAY RATES
Nitrogen Calibration	1	DECAY RATES
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

Segment Morphometry

		Outflow		Area	Depth	Length	Mixed Depth (m)		Hypol Depth		Non-Algal Turb (m^{-1})		Internal Loads (mg/m2-day) Conserv.		Total P		Total N	
Seg	**Name**	**Segment**	**Group**	**km^2**	**m**	**km**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
1	1- Frank Holten Lake 1	2	1	0.17	4	0.96	4	0	0	0	0.08	0.2	0	0	3	0	0	0
2	2- Frank Holten Lake 2	3	2	0.13	6.5	0.65	6.5	0	0	0	0.08	0.2	0	0	3	0	0	0
3	3- Frank Holten Lake 3- North	4	3	0.12	2.4	0.76	2.4	0	0	0	0.08	0.2	0	0	3	0	0	0
4	4- Frank Holten Lake 3- South	0	4	0.22	1.9	0.65	1.9	0	0	0	0.08	0.2	0	0	3	0	0	0

Segment Observed Water Quality

	Conserv		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)		Organic N (ppb)		TP - Ortho P (ppb)		HOD (ppb/day)		MOD (ppb/day)	
Seg	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
1	0	0	166.54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	116.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	144.49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	138.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Segment Calibration Factors

	Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)		Organic N (ppb)		TP - Ortho P (ppb)		HOD (ppb/day)		MOD (ppb/day)	
Seg	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
2	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
3	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
4	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0

Tributary Data

				Dr Area	Flow (hm^3/yr)		Conserv.		Total P (ppb)		Total N (ppb)		Ortho P (ppb)		Inorganic N (ppb)	
Trib	**Trib Name**	**Segment**	**Type**	**km^2**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
1	1- Trib 1	1	2	7.3	3.27	0	0	0	290.77	0.9	0	0	0	0	0	0
2	2- Trib 2	2	2	1.3	0.64	0	0	0	170.32	1	0	0	0	0	0	0
3	3- Trib 3	3	2	3	1.64	0	0	0	207.8	0.83	0	0	0	0	0	0
4	4- Trib 4	4	2	1.4	1.18	0	0	0	59.08	0.52	0	0	0	0	0	0
5	5- Harding Ditch	4	1	0	41.6	0	0	0	365.1	0	0	0	0	0	0	0

Model Coefficients	Mean	CV
Dispersion Rate	1.000	0.70
Total Phosphorus	1.000	0.45
Total Nitrogen	1.000	0.55
Chl-a Model	1.000	0.26
Secchi Model	1.000	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Frank Holten Lakes- Wet
File: **E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\Fr**

Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: 5 Area-Wtd Mean

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	182.8	0.16	93.2%	142.6		88.7%
CHL-A MG/M3	35.9	0.27	95.9%			
SECCHI M	1.1	0.25	51.0%			
ORGANIC N MG/M3	981.9	0.25	92.3%			
TP-ORTHO-P MG/M3	61.7	0.31	77.6%			
ANTILOG PC-1	936.7	0.50	84.7%			
ANTILOG PC-2	15.4	0.08	95.2%			
TURBIDITY 1/M	0.1	0.10	1.1%	0.1	0.10	1.1%
ZMIX * TURBIDITY	0.3	0.11	0.1%	0.3	0.11	0.1%
ZMIX / SECCHI	3.2	0.26	25.1%			
CHL-A * SECCHI	36.5	0.10	96.4%			
CHL-A / TOTAL P	0.2	0.29	57.1%			
FREQ(CHL-a>10) %	93.6	0.05	95.9%			
FREQ(CHL-a>20) %	69.2	0.19	95.9%			
FREQ(CHL-a>30) %	46.4	0.32	95.9%			
FREQ(CHL-a>40) %	30.7	0.43	95.9%			
FREQ(CHL-a>50) %	20.4	0.53	95.9%			
FREQ(CHL-a>60) %	13.8	0.62	95.9%			
CARLSON TSI-P	78.6	0.03	93.2%	75.6		88.7%
CARLSON TSI-CHLA	65.3	0.04	95.9%			
CARLSON TSI-SEC	59.1	0.06	49.0%			

Segment: 1 1- Frank Holten Lake 1

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	162.6	0.20	91.3%	166.5		91.7%
CHL-A MG/M3	39.9	0.27	97.0%			
SECCHI M	0.9	0.26	42.1%			
ORGANIC N MG/M3	1072.4	0.26	94.5%			
TP-ORTHO-P MG/M3	68.8	0.31	80.9%			
ANTILOG PC-1	1055.1	0.50	86.7%			
ANTILOG PC-2	15.3	0.08	95.1%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.3	0.20	0.2%	0.3	0.20	0.2%
ZMIX / SECCHI	4.3	0.26	43.1%			
CHL-A * SECCHI	37.0	0.10	96.6%			
CHL-A / TOTAL P	0.2	0.30	63.8%			
FREQ(CHL-a>10) %	97.3	0.03	97.0%			
FREQ(CHL-a>20) %	78.9	0.15	97.0%			
FREQ(CHL-a>30) %	55.9	0.30	97.0%			
FREQ(CHL-a>40) %	37.6	0.43	97.0%			
FREQ(CHL-a>50) %	25.0	0.55	97.0%			
FREQ(CHL-a>60) %	16.6	0.65	97.0%			
CARLSON TSI-P	77.6	0.04	91.3%	77.9		91.7%

CARLSON TSI-CHLA	66.8	0.04	97.0%			
CARLSON TSI-SEC	61.1	0.06	57.9%			

Segment: **2** **2- Frank Holten Lake 2**

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	118.1	0.24	84.2%	116.3		83.8%
CHL-A MG/M3	23.9	0.27	88.7%			
SECCHI M	1.5	0.25	66.0%			
ORGANIC N MG/M3	707.4	0.24	78.4%			
TP-ORTHO-P MG/M3	40.3	0.32	62.2%			
ANTILOG PC-1	420.5	0.49	66.0%			
ANTILOG PC-2	15.6	0.08	95.4%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.5	0.20	1.0%	0.5	0.20	1.0%
ZMIX / SECCHI	4.4	0.26	44.5%			
CHL-A * SECCHI	35.3	0.11	96.0%			
CHL-A / TOTAL P	0.2	0.32	51.9%			
FREQ(CHL-a>10) %	86.3	0.11	88.7%			
FREQ(CHL-a>20) %	49.0	0.35	88.7%			
FREQ(CHL-a>30) %	24.9	0.55	88.7%			
FREQ(CHL-a>40) %	12.7	0.72	88.7%			
FREQ(CHL-a>50) %	6.7	0.86	88.7%			
FREQ(CHL-a>60) %	3.6	0.97	88.7%			
CARLSON TSI-P	73.0	0.05	84.2%	72.7		83.8%
CARLSON TSI-CHLA	61.7	0.04	88.7%			
CARLSON TSI-SEC	54.4	0.07	34.0%			

Segment: **3** **3- Frank Holten Lake 3- North**

	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	139.9	0.21	88.3%	144.5		89.0%
CHL-A MG/M3	55.9	0.28	99.0%			
SECCHI M	0.7	0.27	26.9%			
ORGANIC N MG/M3	1437.4	0.27	98.5%			
TP-ORTHO-P MG/M3	97.3	0.32	89.2%			
ANTILOG PC-1	1951.1	0.52	94.3%			
ANTILOG PC-2	15.0	0.08	94.7%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.2	0.20	0.0%	0.2	0.20	0.0%
ZMIX / SECCHI	3.5	0.28	30.5%			
CHL-A * SECCHI	37.8	0.10	96.8%			
CHL-A / TOTAL P	0.4	0.29	86.9%			
FREQ(CHL-a>10) %	99.3	0.01	99.0%			
FREQ(CHL-a>20) %	91.1	0.08	99.0%			
FREQ(CHL-a>30) %	75.6	0.18	99.0%			
FREQ(CHL-a>40) %	59.1	0.29	99.0%			
FREQ(CHL-a>50) %	44.8	0.39	99.0%			
FREQ(CHL-a>60) %	33.6	0.48	99.0%			
CARLSON TSI-P	75.4	0.04	88.3%	75.9		89.0%
CARLSON TSI-CHLA	70.1	0.04	99.0%			
CARLSON TSI-SEC	65.6	0.06	73.1%			

Segment: 4 4- Frank Holten Lake 3- South

Variable	Predicted Values---> Mean	CV	Rank	Observed Values---> Mean	CV	Rank
TOTAL P MG/M3	260.0	0.10	97.0%	138.8		88.1%
CHL-A MG/M3	29.1	0.26	92.9%			
SECCHI M	1.2	0.25	57.2%			
ORGANIC N MG/M3	825.7	0.24	86.2%			
TP-ORTHO-P MG/M3	49.5	0.31	70.1%			
ANTILOG PC-1	596.8	0.48	75.2%			
ANTILOG PC-2	15.5	0.08	95.3%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.2	0.20	0.0%	0.2	0.20	0.0%
ZMIX / SECCHI	1.5	0.25	2.6%			
CHL-A * SECCHI	36.0	0.11	96.3%			
CHL-A / TOTAL P	0.1	0.28	18.9%			
FREQ(CHL-a>10) %	92.1	0.06	92.9%			
FREQ(CHL-a>20) %	61.5	0.26	92.9%			
FREQ(CHL-a>30) %	35.9	0.43	92.9%			
FREQ(CHL-a>40) %	20.5	0.59	92.9%			
FREQ(CHL-a>50) %	11.8	0.71	92.9%			
FREQ(CHL-a>60) %	7.0	0.82	92.9%			
CARLSON TSI-P	84.3	0.02	97.0%	75.3		88.1%
CARLSON TSI-CHLA	63.7	0.04	92.9%			
CARLSON TSI-SEC	56.9	0.06	42.8%			

Frank Holten Lakes- Wet
File: E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\FrankHoltenLks_WetCAL.btb

Overall Water & Nutrient Balances

Overall Water Balance

Averaging Period = 0.25 years

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance $(hm3/yr)^2$	CV -	Runoff m/yr
5	1	4	5- Harding Ditch		41.6	0.00E+00	0.00	
PRECIPITATION				0.6	0.8	0.00E+00	0.00	1.18
TRIBUTARY INFLOW					41.6	0.00E+00	0.00	
***TOTAL INFLOW				13.6	42.4	0.00E+00	0.00	3.11
ADVECTIVE OUTFLOW				13.6	42.0	0.00E+00	0.00	3.08
***TOTAL OUTFLOW				13.6	42.0	0.00E+00	0.00	3.08
***EVAPORATION					0.3	0.00E+00	0.00	

Overall Mass Balance Based Upon Predicted Outflow & Reservoir Concentrations

Component: TOTAL P

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	%Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
5	1	4	5- Harding Ditch	15188.2	95.5%	0.00E+00		0.00	365.1	
PRECIPITATION				19.2	0.1%	9.22E+01	99.9%	0.50	25.5	30.0
INTERNAL LOAD				701.3	4.4%	0.00E+00		0.00		
TRIBUTARY INFLOW				15188.2	95.5%	0.00E+00		0.00	365.1	
***TOTAL INFLOW				15908.6	100.0%	9.22E+01	100.0%	0.00	375.6	1166.3
ADVECTIVE OUTFLOW				10926.9	68.7%	1.21E+06		0.10	260.0	801.1
***TOTAL OUTFLOW				10926.9	68.7%	1.21E+06		0.10	260.0	801.1
***RETENTION				4981.8	31.3%	1.21E+06		0.22		

Overflow Rate (m/yr)	65.7	Nutrient Resid. Time (yrs)	0.0256
Hydraulic Resid. Time (yrs)	0.0531	Turnover Ratio	9.8
Reservoir Conc (mg/m3)	183	Retention Coef.	0.313

Frank Holten Lakes- Wet
File: E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\FrankHoltenLks_WetCAL.btb

Hydraulic & Dispersion Parameters

			Net	Resid	Overflow		Dispersion-------->		
		Outflow	Inflow	Time	Rate	Velocity	Estimated	Numeric	Exchange
Seg	**Name**	**Seg**	**hm^3/yr**	**years**	**m/yr**	**km/yr**	**km^2/yr**	**km^2/yr**	**hm^3/yr**
1	1- Frank Holten Lake 1	2	0.1	6.1013	0.7	1.0	1.0	0.1	0.7
2	2- Frank Holten Lake 2	3	0.2	4.2963	1.5	1.0	0.8	0.0	1.6
3	3- Frank Holten Lake 3- No	4	0.3	1.0459	2.3	1.0	1.2	0.3	0.5
4	4- Frank Holten Lake 3- So	0	42.0	0.0099	191.0	65.3	436.6	21.2	0.0

Morphometry

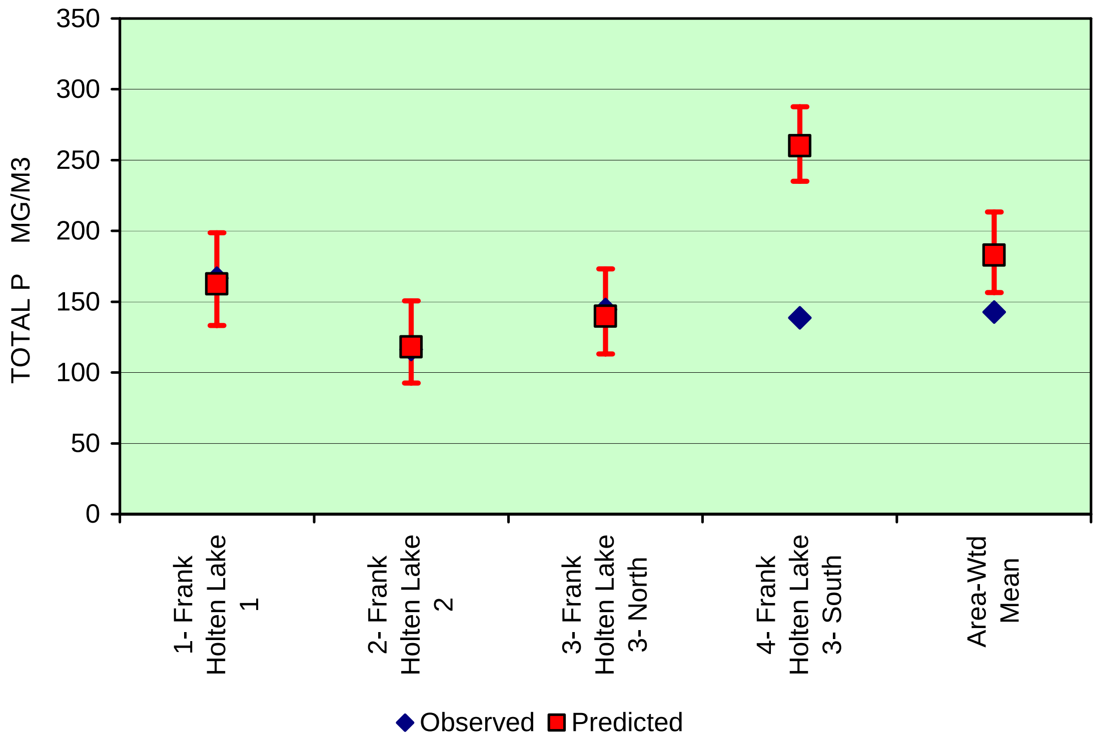
		Area	Zmean	Zmix	Length	Volume	Width	L/W
Seg	**Name**	**km^2**	**m**	**m**	**km**	**hm^3**	**km**	**-**
1	1- Frank Holten Lake 1	0.2	4.0	4.0	1.0	0.7	0.2	5.4
2	2- Frank Holten Lake 2	0.1	6.5	6.5	0.6	0.8	0.2	3.2
3	3- Frank Holten Lake 3- No	0.1	2.4	2.4	0.8	0.3	0.2	4.8
4	4- Frank Holten Lake 3- So	0.2	1.9	1.9	0.6	0.4	0.3	1.9
Totals		0.6	3.5			2.2		

Frank Holten Lakes- Wet

File: **E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\Fra**

Variable: **TOTAL P MG/M3**

	Predicted		Observed	
Segment	**Mean**	**CV**	**Mean**	**CV**
1- Frank Holten Lake 1	162.6	0.20	166.5	0.00
2- Frank Holten Lake 2	118.1	0.24	116.3	0.00
3- Frank Holten Lake 3- Nor	139.9	0.21	144.5	0.00
4- Frank Holten Lake 3- Sou	260.0	0.10	138.8	0.00
Area-Wtd Mean	182.8	0.16	142.6	0.00



Frank Holten Lakes
Wet Weather Scenario- Reduced Loading Conditions
BATHTUB Modeling Files

Frank Holten Lakes- Wet
File: **E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\Frank**

Segment & Tributary Network

--------Segment:	1	1- Frank Holten Lake 1		
Outflow Segment:	2	2- Frank Holten Lake 2		
Tributary:	1	1- Trib 1	Type:	Non Point Inflow
--------Segment:	2	2- Frank Holten Lake 2		
Outflow Segment:	3	3- Frank Holten Lake 3- North		
Tributary:	2	2- Trib 2	Type:	Non Point Inflow
--------Segment:	3	3- Frank Holten Lake 3- North		
Outflow Segment:	4	4- Frank Holten Lake 3- South		
Tributary:	3	3- Trib 3	Type:	Non Point Inflow
--------Segment:	4	4- Frank Holten Lake 3- South		
Outflow Segment:	0	Out of Reservoir		
Tributary:	4	4- Trib 4	Type:	Non Point Inflow
Tributary:	5	5- Harding Ditch	Type:	Monitored Inflow

Frank Holten Lakes- Wet
File: **E:\IEPA-TMDL St 3 Cahokia Creek\Modeling\BATHTUB\FrankHoltenLks\FrankHoltenLks_WetRED.btb**
Description:
March-May

Global Variables	Mean	CV
Averaging Period (yrs)	0.25	0.0
Precipitation (m)	0.2946	0.0
Evaporation (m)	0.1307	0.0
Storage Increase (m)	0	0.0

Atmos. Loads (kg/km^2-yr)	Mean	CV
Conserv. Substance	0	0.00
Total P	30	0.50
Total N	1000	0.50
Ortho P	15	0.50
Inorganic N	500	0.50

Model Options	Code	Description
Conservative Substance	0	NOT COMPUTED
Phosphorus Balance	1	2ND ORDER, AVAIL P
Nitrogen Balance	0	NOT COMPUTED
Chlorophyll-a	2	P, LIGHT, T
Secchi Depth	1	VS. CHLA & TURBIDITY
Dispersion	1	FISCHER-NUMERIC
Phosphorus Calibration	1	DECAY RATES
Nitrogen Calibration	1	DECAY RATES
Error Analysis	1	MODEL & DATA
Availability Factors	0	IGNORE
Mass-Balance Tables	1	USE ESTIMATED CONCS
Output Destination	2	EXCEL WORKSHEET

Segment Morphometry

		Outflow		Area	Depth	Length	Mixed Depth (m)		Hypol Depth		Non-Algal Turb (m^{-1})		Internal Loads (mg/m2-day) Conserv.		Total P		Total N	
Seg	Name	Segment	Group	km^2	m	km	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	1- Frank Holten Lake 1	2	1	0.17	4	0.96	4	0	0	0	0.08	0.2	0	0	0.3	0	0	0
2	2- Frank Holten Lake 2	3	2	0.13	6.5	0.65	6.5	0	0	0	0.08	0.2	0	0	0.3	0	0	0
3	3- Frank Holten Lake 3- North	4	3	0.12	2.4	0.76	2.4	0	0	0	0.08	0.2	0	0	0.3	0	0	0
4	4- Frank Holten Lake 3- South	0	4	0.22	1.9	0.65	1.9	0	0	0	0.08	0.2	0	0	0.3	0	0	0

Segment Observed Water Quality

	Conserv		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)		Organic N (ppb)		TP - Ortho P (ppb)		HOD (ppb/day)		MOD (ppb/day)	
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	0	0	166.54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	116.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	144.49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	138.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Segment Calibration Factors

	Dispersion Rate		Total P (ppb)		Total N (ppb)		Chl-a (ppb)		Secchi (m)		Organic N (ppb)		TP - Ortho P (ppb)		HOD (ppb/day)		MOD (ppb/day)	
Seg	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
2	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
3	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
4	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0

Tributary Data

				Dr Area	Flow (hm^3/yr)		Conserv.		Total P (ppb)		Total N (ppb)		Ortho P (ppb)		Inorganic N (ppb)	
Trib	Trib Name	Segment	Type	km^2	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV	Mean	CV
1	1- Trib 1	1	2	7.3	3.27	0	0	0	29.08	0.9	0	0	0	0	0	0
2	2- Trib 2	2	2	1.3	0.64	0	0	0	17.03	1	0	0	0	0	0	0
3	3- Trib 3	3	2	3	1.64	0	0	0	20.78	0.83	0	0	0	0	0	0
4	4- Trib 4	4	2	1.4	1.18	0	0	0	5.91	0.52	0	0	0	0	0	0
5	5- Harding Ditch	4	1	0	41.6	0	0	0	43.91	0	0	0	0	0	0	0

Model Coefficients	**Mean**	**CV**
Dispersion Rate	1.000	0.70
Total Phosphorus	1.000	0.45
Total Nitrogen	1.000	0.55
Chl-a Model	1.000	0.26
Secchi Model	1.000	0.10
Organic N Model	1.000	0.12
TP-OP Model	1.000	0.15
HODv Model	1.000	0.15
MODv Model	1.000	0.22
Secchi/Chla Slope (m^2/mg)	0.025	0.00
Minimum Qs (m/yr)	0.100	0.00
Chl-a Flushing Term	1.000	0.00
Chl-a Temporal CV	0.620	0
Avail. Factor - Total P	0.330	0
Avail. Factor - Ortho P	1.930	0
Avail. Factor - Total N	0.590	0
Avail. Factor - Inorganic N	0.790	0

Frank Holten Lakes- Wet
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Predicted & Observed Values Ranked Against CE Model Development Dataset

Segment: 5 Area-Wtd Mean

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	42.9	0.13	45.1%	142.6		88.7%
CHL-A MG/M3	18.4	0.28	81.0%			
SECCHI M	1.9	0.25	77.1%			
ORGANIC N MG/M3	583.5	0.24	65.8%			
TP-ORTHO-P MG/M3	30.6	0.34	50.9%			
ANTILOG PC-1	274.1	0.51	53.4%			
ANTILOG PC-2	15.6	0.08	95.4%			
TURBIDITY 1/M	0.1	0.10	1.1%	0.1	0.10	1.1%
ZMIX * TURBIDITY	0.3	0.11	0.1%	0.3	0.11	0.1%
ZMIX / SECCHI	1.9	0.26	5.2%			
CHL-A * SECCHI	33.9	0.11	95.5%			
CHL-A / TOTAL P	0.4	0.26	89.1%			
FREQ(CHL-a>10) %	73.1	0.19	81.0%			
FREQ(CHL-a>20) %	32.7	0.48	81.0%			
FREQ(CHL-a>30) %	14.2	0.70	81.0%			
FREQ(CHL-a>40) %	6.5	0.88	81.0%			
FREQ(CHL-a>50) %	3.1	1.02	81.0%			
FREQ(CHL-a>60) %	1.6	1.15	81.0%			
CARLSON TSI-P	58.3	0.03	45.1%	75.6		88.7%
CARLSON TSI-CHLA	59.0	0.05	81.0%			
CARLSON TSI-SEC	51.0	0.07	22.9%			

Segment: 1 1- Frank Holten Lake 1

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	48.3	0.19	50.3%	166.5		91.7%
CHL-A MG/M3	21.8	0.30	86.3%			
SECCHI M	1.6	0.27	69.7%			
ORGANIC N MG/M3	660.9	0.25	74.3%			
TP-ORTHO-P MG/M3	36.7	0.35	58.4%			
ANTILOG PC-1	359.2	0.54	61.5%			
ANTILOG PC-2	15.6	0.08	95.4%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.3	0.20	0.2%	0.3	0.20	0.2%
ZMIX / SECCHI	2.5	0.28	13.4%			
CHL-A * SECCHI	34.9	0.11	95.9%			
CHL-A / TOTAL P	0.5	0.26	90.6%			
FREQ(CHL-a>10) %	82.9	0.14	86.3%			
FREQ(CHL-a>20) %	43.3	0.43	86.3%			
FREQ(CHL-a>30) %	20.5	0.67	86.3%			
FREQ(CHL-a>40) %	9.9	0.85	86.3%			
FREQ(CHL-a>50) %	5.0	1.01	86.3%			
FREQ(CHL-a>60) %	2.6	1.14	86.3%			

CARLSON TSI-P	60.1	0.05	50.3%	77.9		91.7%
CARLSON TSI-CHLA	60.9	0.05	86.3%			
CARLSON TSI-SEC	53.2	0.07	30.3%			

Segment: 2 — 2- Frank Holten Lake 2

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	39.7	0.20	41.8%	116.3		83.8%
CHL-A MG/M3	14.6	0.29	71.5%			
SECCHI M	2.3	0.26	83.3%			
ORGANIC N MG/M3	494.9	0.23	53.4%			
TP-ORTHO-P MG/M3	23.7	0.35	40.2%			
ANTILOG PC-1	177.4	0.52	40.3%			
ANTILOG PC-2	15.5	0.08	95.3%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.5	0.20	1.0%	0.5	0.20	1.0%
ZMIX / SECCHI	2.9	0.26	19.4%			
CHL-A * SECCHI	32.8	0.12	95.0%			
CHL-A / TOTAL P	0.4	0.27	83.7%			
FREQ(CHL-a>10) %	61.6	0.29	71.5%			
FREQ(CHL-a>20) %	20.5	0.66	71.5%			
FREQ(CHL-a>30) %	7.0	0.92	71.5%			
FREQ(CHL-a>40) %	2.6	1.13	71.5%			
FREQ(CHL-a>50) %	1.1	1.29	71.5%			
FREQ(CHL-a>60) %	0.5	1.43	71.5%			
CARLSON TSI-P	57.2	0.05	41.8%	72.7		83.8%
CARLSON TSI-CHLA	56.9	0.05	71.5%			
CARLSON TSI-SEC	48.3	0.08	16.7%			

Segment: 3 — 3- Frank Holten Lake 3- North

	Predicted Values--->			Observed Values--->		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	40.8	0.17	42.9%	144.5		89.0%
CHL-A MG/M3	23.0	0.31	87.7%			
SECCHI M	1.5	0.29	67.6%			
ORGANIC N MG/M3	687.0	0.26	76.7%			
TP-ORTHO-P MG/M3	38.7	0.36	60.6%			
ANTILOG PC-1	393.1	0.56	64.1%			
ANTILOG PC-2	15.6	0.08	95.4%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.2	0.20	0.0%	0.2	0.20	0.0%
ZMIX / SECCHI	1.6	0.29	2.8%			
CHL-A * SECCHI	35.1	0.11	96.0%			
CHL-A / TOTAL P	0.6	0.26	95.1%			
FREQ(CHL-a>10) %	84.9	0.13	87.7%			
FREQ(CHL-a>20) %	46.6	0.42	87.7%			
FREQ(CHL-a>30) %	23.0	0.66	87.7%			
FREQ(CHL-a>40) %	11.4	0.85	87.7%			
FREQ(CHL-a>50) %	5.9	1.01	87.7%			
FREQ(CHL-a>60) %	3.2	1.14	87.7%			
CARLSON TSI-P	57.6	0.04	42.9%	75.9		89.0%

CARLSON TSI-CHLA	61.4	0.05	87.7%
CARLSON TSI-SEC	53.9	0.08	32.4%

Segment:	**4**	**4- Frank Holten Lake 3- South**				
	Predicted Values--->			**Observed Values--->**		
Variable	**Mean**	**CV**	**Rank**	**Mean**	**CV**	**Rank**
TOTAL P MG/M3	41.7	0.03	43.9%	138.8		88.1%
CHL-A MG/M3	15.6	0.26	74.6%			
SECCHI M	2.1	0.23	81.3%			
ORGANIC N MG/M3	519.6	0.22	57.1%			
TP-ORTHO-P MG/M3	25.6	0.32	43.4%			
ANTILOG PC-1	200.7	0.46	43.9%			
ANTILOG PC-2	15.6	0.08	95.4%			
TURBIDITY 1/M	0.1	0.20	1.1%	0.1	0.20	1.1%
ZMIX * TURBIDITY	0.2	0.20	0.0%	0.2	0.20	0.0%
ZMIX / SECCHI	0.9	0.24	0.2%			
CHL-A * SECCHI	33.2	0.11	95.2%			
CHL-A / TOTAL P	0.4	0.26	84.6%			
FREQ(CHL-a>10) %	66.0	0.23	74.6%			
FREQ(CHL-a>20) %	24.0	0.55	74.6%			
FREQ(CHL-a>30) %	8.7	0.78	74.6%			
FREQ(CHL-a>40) %	3.4	0.96	74.6%			
FREQ(CHL-a>50) %	1.4	1.11	74.6%			
FREQ(CHL-a>60) %	0.7	1.23	74.6%			
CARLSON TSI-P	57.9	0.01	43.9%	75.3		88.1%
CARLSON TSI-CHLA	57.6	0.04	74.6%			
CARLSON TSI-SEC	49.1	0.07	18.7%			

Frank Holten Lakes- Wet
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Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 0.25 years**

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance $(hm3/yr)^2$	CV -	Runoff m/yr
5	1	4	5- Harding Ditch		41.6	0.00E+00	0.00	
PRECIPITATION				0.6	0.8	0.00E+00	0.00	1.18
TRIBUTARY INFLOW					41.6	0.00E+00	0.00	
***TOTAL INFLOW				13.6	42.4	0.00E+00	0.00	3.11
ADVECTIVE OUTFLOW				13.6	42.0	0.00E+00	0.00	3.08
***TOTAL OUTFLOW				13.6	42.0	0.00E+00	0.00	3.08
***EVAPORATION					0.3	0.00E+00	0.00	

Overall Mass Balance Based Upon Component: **Predicted TOTAL P** — **Outflow & Reservoir Concentrations**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	%Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
5	1	4	5- Harding Ditch	1826.7	95.3%	0.00E+00		0.00	43.9	
PRECIPITATION				19.2	1.0%	9.22E+01	100.0%	0.50	25.5	30.0
INTERNAL LOAD				70.1	3.7%	0.00E+00		0.00		
TRIBUTARY INFLOW				1826.7	95.3%	0.00E+00		0.00	43.9	
***TOTAL INFLOW				1916.0	100.0%	9.22E+01	100.0%	0.01	45.2	140.5
ADVECTIVE OUTFLOW				1752.6	91.5%	2.47E+03		0.03	41.7	128.5
***TOTAL OUTFLOW				1752.6	91.5%	2.47E+03		0.03	41.7	128.5
***RETENTION				163.4	8.5%	2.49E+03		0.31		

Overflow Rate (m/yr)	65.7	Nutrient Resid. Time (yrs)	0.0499
Hydraulic Resid. Time (yrs)	0.0531	Turnover Ratio	5.0
Reservoir Conc (mg/m3)	43	Retention Coef.	0.085

Frank Holten Lakes- Wet

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Hydraulic & Dispersion Parameters

Seg	Name	Outflow Seg	Net Inflow hm^3/yr	Resid Time years	Overflow Rate m/yr	Velocity km/yr	Dispersion--------> Estimated km^2/yr	Numeric km^2/yr	Exchange hm^3/yr
1	1- Frank Holten Lake 1	2	0.1	6.1013	0.7	1.0	1.0	0.1	0.7
2	2- Frank Holten Lake 2	3	0.2	4.2963	1.5	1.0	0.8	0.0	1.6
3	3- Frank Holten Lake 3- North	4	0.3	1.0459	2.3	1.0	1.2	0.3	0.5
4	4- Frank Holten Lake 3- South	0	42.0	0.0099	191.0	65.3	436.6	21.2	0.0

Morphometry

Seg	Name	Area km^2	Zmean m	Zmix m	Length km	Volume hm^3	Width km	L/W -
1	1- Frank Holten Lake 1	0.2	4.0	4.0	1.0	0.7	0.2	5.4
2	2- Frank Holten Lake 2	0.1	6.5	6.5	0.6	0.8	0.2	3.2
3	3- Frank Holten Lake 3- North	0.1	2.4	2.4	0.8	0.3	0.2	4.8
4	4- Frank Holten Lake 3- South	0.2	1.9	1.9	0.6	0.4	0.3	1.9
Totals		0.6	3.5			2.2		

Frank Holten Lakes- Wet

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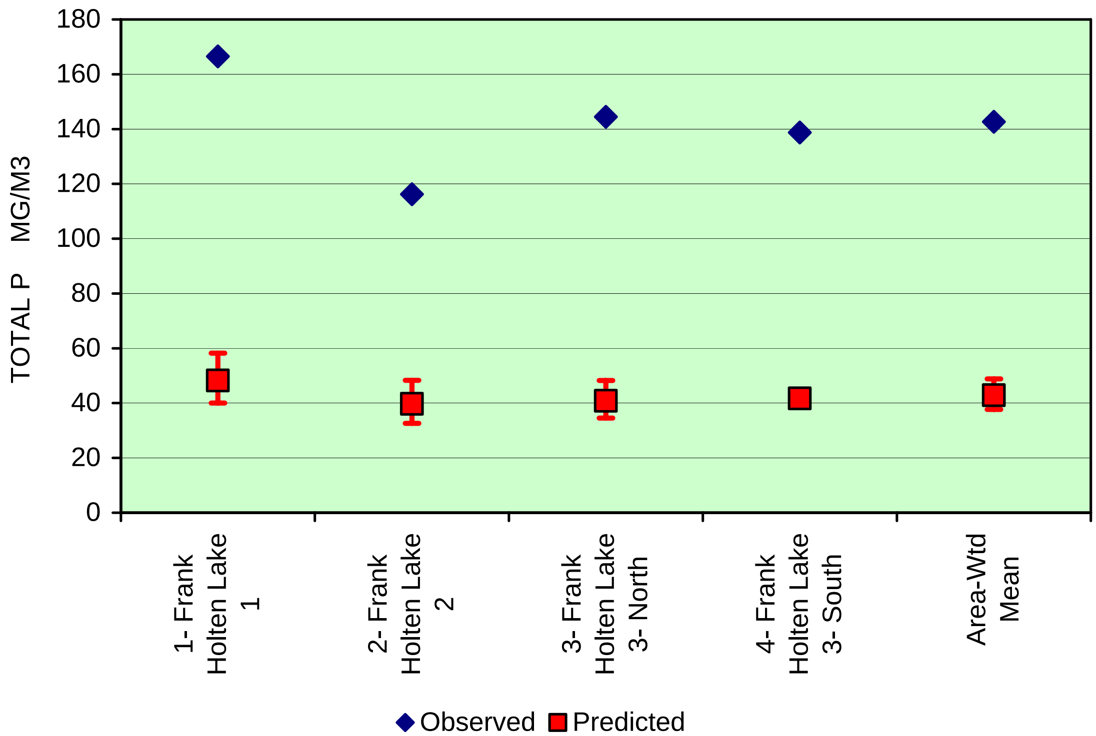
Variable: **TOTAL P MG/M3**

Segment	Predicted Mean	CV	Observed Mean	CV
1- Frank Holten Lake 1	48.3	0.19	166.5	0.00
2- Frank Holten Lake 2	39.7	0.20	116.3	0.00
3- Frank Holten Lake 3- Nor	40.8	0.17	144.5	0.00
4- Frank Holten Lake 3- Sou	41.7	0.03	138.8	0.00
Area-Wtd Mean	42.9	0.13	142.6	0.00



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